



ATIS-1000110.1999 (R2015)

**SIGNALLING SYSTEM NUMBER 7 (SS7) –
GENERAL INFORMATION**



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Revision of
ANSI T1.110-1992

American National Standard
for Telecommunications –
Signalling System No. 7 (SS7) –
General Information

Secretariat

Alliance for Telecommunications Industry Solutions

Approved January 13, 2000

American National Standards Institute, Inc.

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(NOTE - A detailed table of contents is provided at the beginning of each chapter.)

Foreword (This foreword is not part of American National Standard T1.110-1999.)

This document is entitled *American National Standard for Telecommunications - Signalling System Number 7 (SS7) - General Information*. It was originally based on the 1988 Blue Book specification of Signalling System No. 7 (SS#7) for international use, issued by the CCITT Study Group XI (Vol. VI, Fascicles VI.7 and VI.8) and is intended to be generally compatible with that standard and its successors. It has been appropriately modified for use within and between U.S. networks to meet the anticipated needs and applications of such entities. These modifications are the result of extensive work by the members of the T1S1.3 (formerly T1X1.1) Working Group on U.S. Standards for Common Channel Signalling. In general, these modifications fall into two categories:

- 1) The specification of options designated by the ITU-T (formerly CCITT) for national use,
- 2) Extensions to the 1992 protocol to provide for new applications of the SS#7 protocol. This is in accordance with current and projected ITU-T activity.

A vertical bar in the margin shows changes from ANSI T1.110-1992. Annotation rules are discussed in ANSI T1.110.4. Within ANSI T1.110-1999, the following protocol terms are used:

ITU-T SS#7 or SS#7 - International Signalling System No. 7

SS7 - The U.S. version of Signalling System No. 7

The objectives of the implementation of SS7 in the U.S. networks go beyond basic circuit-switched call control signalling, and place major emphasis on the support of advanced capabilities such as signalling for Integrated Services Digital Networks (ISDN), support of an Operations, Administration and Maintenance (OA&M) application, support of Transaction Capabilities, support of SS7 based services, and others yet to be defined. National versions of the 1988 Blue Book and later versions Telephone User Part (TUP) and Data User Part (DUP) are not included in this document and will not be supported in U.S. networks. Instead, information describing additional protocol capabilities and new applications is provided. Further information on new applications will be included as detailed definition work proceeds within ITU-T and within T1.

This specification of SS7 consists of seven standards, ANSI T1.110 through ANSI T1.116. They respectively cover the System General Information, the Message Transfer Part (basic transport), the Signalling Connection Control Part (enhanced transport), the Integrated Services Digital Network User Part (call control), the Transaction Capabilities Application Part (non-circuit related signalling), the SS7 Network Monitoring and Measurements (OA&M measurements), and the Operations, Maintenance and Administration Part (OA&M procedures). The overall and detailed organization of these specifications parallels that used in the equivalent ITU-T recommendations, which are part of the Q.7nn series, and are appropriately identified in the respective individual Forewords.

The standards that make up this specification are as follows:

ANSI T1.110 General Information

Chapter T1.110.1 Overview

Chapter T1.110.2 Glossary

Chapter T1.110.3 Abbreviations

Chapter T1.110.4 Annotation and Format Rules

ANSI T1.111 Message Transfer Part

Chapter T1.111.1 Functional Description of the Signalling System Message Transfer Part (MTP)

Chapter T1.111.2 Signalling Data Link

Chapter T1.111.3 Signalling Link

Chapter T1.111.4 Signalling Network Functions and Messages

Chapter T1.111.5 Signalling Network Structure

Chapter T1.111.6 Message Transfer Part Signalling Performance

Chapter T1.111.7 Testing and Maintenance

Chapter T1.111.8 Numbering of Signalling Point Codes

ANSI T1.112 Signalling Connection Control Part

Chapter T1.112.1 Functional Description of the Signalling Connection Control Part (SCCP)

Chapter T1.112.2 Definition and Function of SCCP Messages

Chapter T1.112.3 SCCP Format and Codes

Chapter T1.112.4 Signalling Connection Control Part Procedures

Chapter T1.112.5 Signalling Connection Control Part Performance

ANSI T1.113 Integrated Services Digital Network (ISDN) User Part

Chapter T1.113.1 Functional Description of the Integrated Services Digital Network (ISDN) User Part

Chapter T1.113.2 General Function of Messages and Signals

Chapter T1.113.3 Formats and Codes

Chapter T1.113.4 Signalling Performance

Chapter T1.113.5 Performance Objectives in the ISDN Application

ANSI T1.114 Transaction Capabilities Application Part (TCAP)

Chapter T1.114.1 Functional Description of Transaction Capabilities

Chapter T1.114.2 Definition and Functions of Transactions Capabilities Messages

Chapter T1.114.3 Transaction Capabilities Formats and Codes

Chapter T1.114.4 Transaction Capabilities Procedures

Chapter T1.114.5 Definitions and Functions of Transaction Capabilities Operations, Parameters, and Error Codes

ANSI T1.115 Monitoring and Measurements for Networks

ANSI T1.116 Operations, Maintenance and Administration Part (OMAP)

ANSI T1.648 Broadband Integrated Services Digital Network (B-ISDN) User Part

Chapter T1.648.1 Functional Description of the B-ISDN User Part (B-ISUP) of Signalling System No. 7

Chapter T1.648.2 General Functions of Messages and Signals of the B-ISDN User Part (B-ISUP) of Signalling System No. 7

Chapter T1.648.3 Broadband ISDN User Part Formats and Codes

Chapter T1.648.4 Signalling Procedures

Chapter T1.648.5 Overview of ANSI B-ISDN NNI Signalling Capability Set 2, Step 1

ANSI T1.110 contains the following four chapters:

- (1) T1.110.1 Overview
- (2) T1.110.2 Glossary
- (3) T1.110.3 Abbreviations
- (4) T1.110.4 Annotation and Format Rules

The Overview chapter is a general introduction to SS7 (based on CCITT Q.700). The Glossary and Abbreviations chapters apply to all volumes of the SS7 specification. The annotation rules that are used throughout the specification indicate special editorial practices and notations.

Although this is an American National Standard published by ANSI, a number of Canadian entities participate in the T1S1.3 (formerly T1X1.1) Working Group to ensure compatibility between U.S. and Canadian standards in this area.

The first issue of ANSI T1.110 was published in 1987. Issue two was published in 1992. This is the third issue of ANSI T1.110, of which the major changes from the second issue are:

- T1.110.1 "Overview" is substantially expanded to include the Broadband ISDN User Part;
- T1.110.2 "Glossary" and T1.110.3 "Abbreviations" are updated with a few minor changes;
- T1.110.4 "Annotation and Format Rules" is simplified.

Future control of this document will reside with Accredited Standards Committee on Telecommunications, T1. This control of additions to the specification, such as ongoing protocol evolution, new applications, and operational requirements, will permit compatibility among U.S. networks. Such additions will be incorporated in an orderly manner with due consideration to the ITU-T layer model principles, conventions, and functional boundaries.

Suggestions for improvement of this standard will be welcomed. They should be sent to the Alliance for Telecommunications Industry Solutions, 1200 G Street, NW, Suite 500, Washington, DC 20005.

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Chapter T1.110.1

Overview

Chapter T1.110.1 OVERVIEW

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American National Standard for Telecommunications –

Signalling System No. 7 (SS7) – General Information

Chapter T1.110.1

Overview

1 Scope, Purpose and Application

ANSI T1.110-1999 was originally based on the 1988 Blue Book specification of Signalling System No. 7 (SS#7) for international use issued by the CCITT Study Group XI (Vol. VI Fascicles VI.7 and VI.8) and is intended to be generally compatible with that standard and its successors. It has been appropriately modified for use within and between U.S. networks to meet the anticipated needs and applications of those entities. In general, these modifications fall into two categories:

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- (2) Extensions to the 1992 protocol to provide for new applications of the SS7 protocol.

This is in accordance with current and projected ITU-T activity.

The objectives of the implementation of SS7 in U.S. networks go beyond basic circuit switched call control signalling, and place major emphasis on the support of advanced capabilities such as signalling for Integrated Services Digital Networks (ISDN), support of an Operations Administration and Maintenance (OA&M) application, support of Transaction Capabilities, and others yet to be defined. National versions of the 1988 Blue Book and later versions of the Telephone User Part (TUP) and Data User Part (DUP)¹ will not be included in this document and will not be supported in U.S. networks. Instead, information describing additional protocol capabilities and new applications is provided. Further information on new applications will be included as detailed definition work proceeds.

Within this document, the following protocol terms are used:

- ITU-T SS#7 or SS#7 - International Signalling System No. 7
- SS7 - The U.S. version of Signalling System No. 7

The contents of this standard generally follow the outline and organization of the existing ITU-T 1992 specification using the same chapter titles as appropriate.

This standard is the first of a series of standards dealing with SS7.

- (1) In this document, Chapters T1.110.2 through T1.110.4 present the Glossary, Abbreviations, and Annotation Rules.
- (2) ANSI T1.111 (the Message Transfer Part (MTP) consists of Chapters T1.111.1 through T1.111.8 and specifies the basic transport mechanisms of SS7.
- (3) ANSI T1.112 (Signalling Connection Control Part (SCCP) consists of Chapters T1.112.1 through T1.112.5 and specifies enhancements to the basic SS7 capabilities.

A "I" symbol indicates a change from the previous issue.

¹) Not specified for U.S. Networks

- (4) ANSI T1.113 (Integrated Services Digital Network User Part (ISDN-UP or ISUP)) consists of Chapters T1.113.1 through T1.113.5, and specifies the protocol for ISDN circuit switched call control signalling.
- (5) ANSI T1.114 (Transaction Capabilities Application Part) consists of Chapters T1.114.1 through T1.114.5, and specifies the application protocol for noncircuit-related signalling in SS7.
- (6) ANSI T1.115 (Monitoring and Measurements for Signalling System No.7 (SS7) Networks) specifies the overall SS7 network measurement features.
- (7) ANSI T1.116 (Operations, Maintenance and Administration Part (OMAP)) consists of Chapters T1.116.0 through T1.116.6, and specifies the application protocol for OA&M of SS7 network.
- (8) ANSI T1.611 (SS7 Supplementary Services for Non-ISDN Subscribers) specifies a set of SS7-based services for non-ISDN subscribers.
- (9) ANSI T1.648 (Broadband Integrated Services Digital Network User Part (B-ISUP)) consists of Chapters T1.648 through T1.648.4 and specifies the protocol for Capability Set 1 (CS 1) B-ISDN circuit switched call signalling.
- (10) ANSI T1.665 (Overview of ANSI B-ISDN NNI Signalling Capability Set 2, Step 1) provides an overview of the capabilities of the ANSI Broadband ISDN Network Node Interface (B-ISDN NNI) for the Broadband ISDN Signalling Capability Set 2, Step 1.
- (11) ANSI T1.640 (Broadband ISDN Network Node Interfaces and Inter Network Interfaces – Rates and Formats Specifications) defines the ATM rates and formats.
- (12) ANSI T1.646 (Broadband ISDN and DS1/ATM User-Network Interfaces: Physical Layer Specification) defines the physical layer for the use of SAAL/ATM in place of MTP 1 and MTP 2.
- (13) ANSI T1.627 (Broadband ISDN – ATM Layer Functionality and Specification) defines ATM functionality.
- (14) ANSI T1.636 (B-ISDN Signaling ATM Adaptation Layer – Overview Description) provides an overview of the SAAL.
- (15) ANSI T1.635 (Broadband ISDN – ATM Adaptation Layer Type 5 Common Part Functions and Specification) describes the common elements of the SAAL.
- (16) ANSI T1.637 (B-ISDN Signaling ATM Adaptation Layer – Service Specific Connection Oriented Protocol (SSCOP)) defines the SSCOP for SAAL.
- (17) ANSI T1.645 (B-ISDN Signaling ATM Adaptation Layer – Service Specific Coordination Function for Support of Signaling at the Network Node Interface (SSCF at the NNI)) defines the SSCF for SAAL.
- (18) ANSI T1.652 (B-ISDN Signaling ATM Adaptation Layer – Layer Management for the SAAL at the NNI) defines layer management for the SAAL.

1.1 Objectives and Fields of Application

The overall objective of Signalling System No. 7 is to provide an internationally standardized, general purpose, Common Channel Signalling (CCS) system:

- (1) Optimized for operation in digital telecommunications networks in conjunction with stored program controlled exchanges;
- (2) That can meet present and future requirements of information transfer (circuit and non-circuit related) for interprocessor transactions within telecommunications networks for call control, remote control, network database access, and management and maintenance signalling;
- (3) That provides a reliable means of transfer of information in correct sequence and without loss or duplication.

The signalling system meets requirements of call control signalling for telecommunication services such as the telephone and circuit-switched data transmission services. It can also be used as a reliable system for other types of information transfer between exchanges and specialized centers in telecommunications

networks (e.g., for management and maintenance purposes). The system is thus applicable for multipurpose uses in networks that are dedicated for particular services and in multiservices networks. The signalling system is intended to be applicable in international and national networks.

The signalling system is optimized for operation over 56, 64 kbit/s digital channels or over higher speed (e.g., 1.5 Mbit/s) Asynchronous Transfer Mode (ATM) links. The system is suitable for use on point-to-point terrestrial and satellite links. It does not include the special features required for use in point-to-multipoint operation but can, if required, be extended to cover such an application.

This standard is intended for use with other American National Standards. When the standards referenced in the requirements are superseded by revisions approved by the American National Standards Institute, Inc., the revision shall apply.

1.2 General Characteristics

Common channel signalling is a signalling method in which a single channel conveys, by means of labeled messages, signalling information relating to, for example, a multiplicity of circuits, services provided by network databases, or other information such as that used for network management. Common channel signalling can be regarded as a form of data communication that is specialized for various types of signalling and information transfer between processors in telecommunications networks.

The signalling system uses signalling links for transfer of signalling messages between exchanges or other nodes in the telecommunication network served by the system. Arrangements are provided to ensure reliable transfer of signalling information in the presence of transmission disturbances or network failures. These include error detection and correction on each signalling link. The system is normally applied with redundancy of signalling links, and it includes functions for automatic diversion of signalling traffic to alternative paths in case of link failures. The capacity and reliability for signalling may thus be dimensioned by provision of a multiplicity of signalling links according to the requirements of each application.

1.3 Modularity

The wide scope of the signalling system requires that the total system include a large diversity of functions and that further functions can be added to cater for extended future applications. As a consequence, only a subset of the total system may need to be used in an individual application.

A major characteristic of the signalling system is that it is specified with a functional structure to ensure flexibility and modularity for diverse applications within one system concept. It allows the system to be realized as a number of functional modules that could ease adaptation of the functional content of an operating Signalling System No. 7 to the requirements of its application.

The ITU-T specifications of the signalling system specify functions and their use for international operation of the system. Many of those functions are also required in typical national applications. Furthermore, the system to some extent includes features that are particular to national applications. The ITU-T specifications thus form an internationally standardized base for a wide range of national applications such as this U.S. standard application of common channel signalling.

Signalling System No. 7 is one common channel signalling system. However, as a consequence of its modularity and its intended use as a standard base for national applications, the system may be applied in many forms. In general, to define the use of the system in this U.S. standard application, a selection of the ITU-T-specified functions has been made, and the necessary additional national functions have been specified based on the nature of the application. This document represents the set of features specified for Signalling System No. 7 operation in U.S. networks.

2 SS7 Signalling Network

2.1 Basic Concepts

A telecommunications network served by common channel signalling is composed of a number of switching and processing nodes interconnected by transmission links. To communicate using SS7, each of these nodes is required to implement the necessary "within node" features of SS7 making that node a signalling point within the SS7 network. In addition, there will be a need to interconnect these signalling points such that the SS7 signalling information (data) may be conveyed between them. These data links are the signalling links of SS7 signalling network.

The combination of signalling points and their interconnecting signalling links form the SS7 signalling network.

2.2 Signalling Network Components

2.2.1 Signalling points

In specific cases there may be a need to partition the common channel signalling functions at such a (physical) node into logically separate entities from a signalling network point of view; i.e., a given (physical) node may be defined as more than one signalling point. One example is an exchange at the boundary between international and national signalling networks.

Any two signalling points, for which the possibility of communication between their corresponding User Part function exists, are said to have a signalling relation.

The corresponding concept for a given User Part is called a user signalling relation.

An example is when two exchanges are directly connected by a group of speech circuits. The exchange of signalling relating to these circuits then constitutes a user signalling relation between the ISDN User Part functions in those exchanges in their role as signalling points.

Another example is when administration of customer and routing data in a telephone exchange is remotely controlled from an operation and maintenance center by means of communication through a common channel signalling system.

Examples of nodes in a signalling network that constitute signalling points are:

- exchanges (switching centers),
- signalling transfer point,
- operation, administration and maintenance centers,
- service control points.

All signalling points in a SS7 network are identified by a unique code known as a point code (as referred in chapter T1.111.4 of ANSI T1.111).

2.2.2 Signalling links

The common channel signalling system uses signalling links to convey the signalling messages between two signalling points. A number of signalling links that directly interconnect two signalling points that are used as a module constitute a signalling link set. Although a link set typically includes all parallel signalling links, it is possible to use more than one link set in parallel between two signalling points. A group of links within a link set that have identical characteristics (e.g., the same data link bearer rate) is called a link group.

Two signalling points that are directly interconnected by a signalling link are, from a signalling network structure point of view, referred to as adjacent signalling points. Correspondingly, two signalling points that are not directly interconnected are non-adjacent signalling points.

2.2.3 Signalling modes

The term “signalling mode” refers to the association between the path taken by a signalling message and the signalling relation to which the message refers.

In the associated mode of signalling, the messages relating to a particular signalling relation between two adjacent points are conveyed over a link set, directly interconnecting those signalling points.

In the non-associated mode of signalling, the messages relating to a particular signalling relation are conveyed over two or more link sets in tandem passing through one or more signalling points other than those which are the origin and the destination of the messages.

The quasi-associated mode of signalling is a limited case of the non-associated mode where the path taken by the message through the signalling network is pre-determined and, at a given point in time, fixed.

Signalling System No.7 is specified for use in the associated and quasi-associated modes. The Message Transfer Part does not include features to avoid out-of-sequence arrival of messages or other problems that would typically arise in a fully non-associated mode of signalling with dynamic message routing.

Examples of signalling modes are illustrated in Figure 1/T1.110.1.

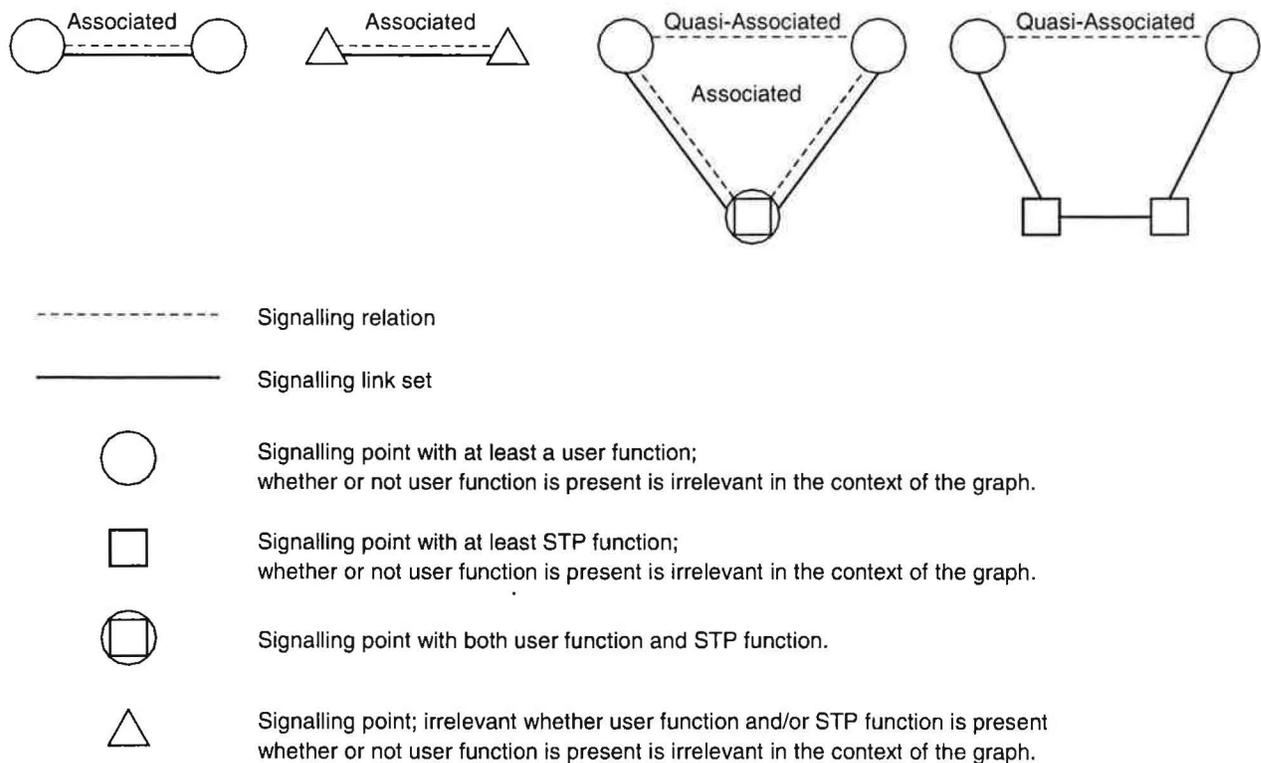


Figure 1/T1.110.1 - Example of Associated and Quasi-Associated Signalling Modes and Definition of Signalling Network Graph Symbols

2.3 Signalling Point Modes

A signalling point at which a message is generated (i.e., the location of the source User or Application Part function) is the originating point of that message.

A signalling point to which a message is destined (i.e., the location of the receiving User or Application Part function) is the destination point of that message.

A signalling point at which a message is received on a signalling link and is transferred to another link, i.e., neither the location of the source nor the receiving User or Application part function, is a Signalling Transfer Point (STP).

For a particular signalling relation, the two signalling points thus function as originating and destination points for the messages exchanged in the two directions between them.

In the quasi-associated mode, the function of a signalling transfer point is typically located in a few signalling points that may be dedicated to this function, or may combine this function with some other (e.g., switching) function. A signalling point serving as a signalling transfer point functions as an originating and destination point for the messages generated and received by the level 3 function of the Message Transfer Part and in cases when no user functions are present.

2.4 Signalling Routes

The pre-determined path, consisting of a succession of signalling points/signalling transfer points and the interconnecting signalling links, that a message takes through the signalling network between the origination point and the destination point is the signalling route for that signalling relation.

All the signalling routes that may be used between an originating point and a destination point by a message traversing the signalling network is the signalling route set for that signalling relation.

2.5 Signalling Network Structure

The signalling system may be used with different types of signalling network structures. The choice between different types of signalling network structures may be influenced by factors such as the structure of the telecommunication network to be served by the signalling system and administrative aspects.

In the case when the provision of the signalling system is planned purely on a per signalling relation basis, the likely result is a signalling network largely based on associated signalling, typically supplemented by a limited degree of quasi-associated signalling for low volume signalling relations. The structure of such a signalling network is mainly determined by the patterns of the signalling relations.

Another approach is to consider the signalling networks as a common resource that should be planned according to the total needs for common channel signalling. The high capacity of digital signalling links in combination with the needs for redundancy for reliability then typically leads to a signalling network based on a high degree of quasi-associated signalling with some provision for associated signalling for high volume signalling relations. The latter approach to signalling network planning is more likely to allow exploitation of the potential of common channel signalling to support network features that require communication for purposes other than the switching of connections.

The worldwide signalling network is structured into two functionally independent levels, namely the international and national levels. This structure makes possible a clear division of responsibility for signalling network management and allows numbering plans of signalling points of the international network and the different national networks to be independent of one another.

Further considerations about the structure of the signalling network are given in chapter T1.111.5 of ANSI T1.111, and the impact on the Message Transfer Part in chapter T1.111.1 of ANSI T1.111.

3 SS7 Functional blocks

3.1 Basic Functional Division

The ANSI Signalling System No.7 comprises the following functional blocks

- Message Transfer Part (MTP)
(or SAAL/ATM with MTP 3)
- ISDN User Part (ISDN-UP)
- Signalling Connection Control Part (SCCP)
- Transaction Capabilities (TC)
- Application Entity (AE)
- Application Service Elements (ASEs)
- the B-ISDN User Part (B-ISDN-UP)

The fundamental principle of the signalling system structure is the division of functions into a common Message Transfer Part (MTP) on one hand, and separate User Parts for different users on the other. This is illustrated in Figure 2/T1.110.1.

The overall function of the Message Transfer Part (or SAAL/ATM with MTP 3) is to serve as a transport system providing reliable transfer of signalling messages between the locations of communicating user functions.

User functions in SS7 MTP terms are

- the ISDN User Part (ISDN-UP)
- the Signalling Connection Control Part (SCCP)
- the B-ISDN User Part (B-ISDN-UP)

The term "User" in the context refers to any functional entity that utilizes the transport capability provided by the Message Transfer Part.

A User Part comprises those functions of, or related to, a particular type of user that are a part of the common channel signalling system, typically because those functions need to be specified in a signalling context.

The SCCP also has Users. These are:

- the ISDN User Part (ISDN-UP)
- Transaction Capabilities (TC)
- the B-ISDN User Part (B-ISDN-UP)

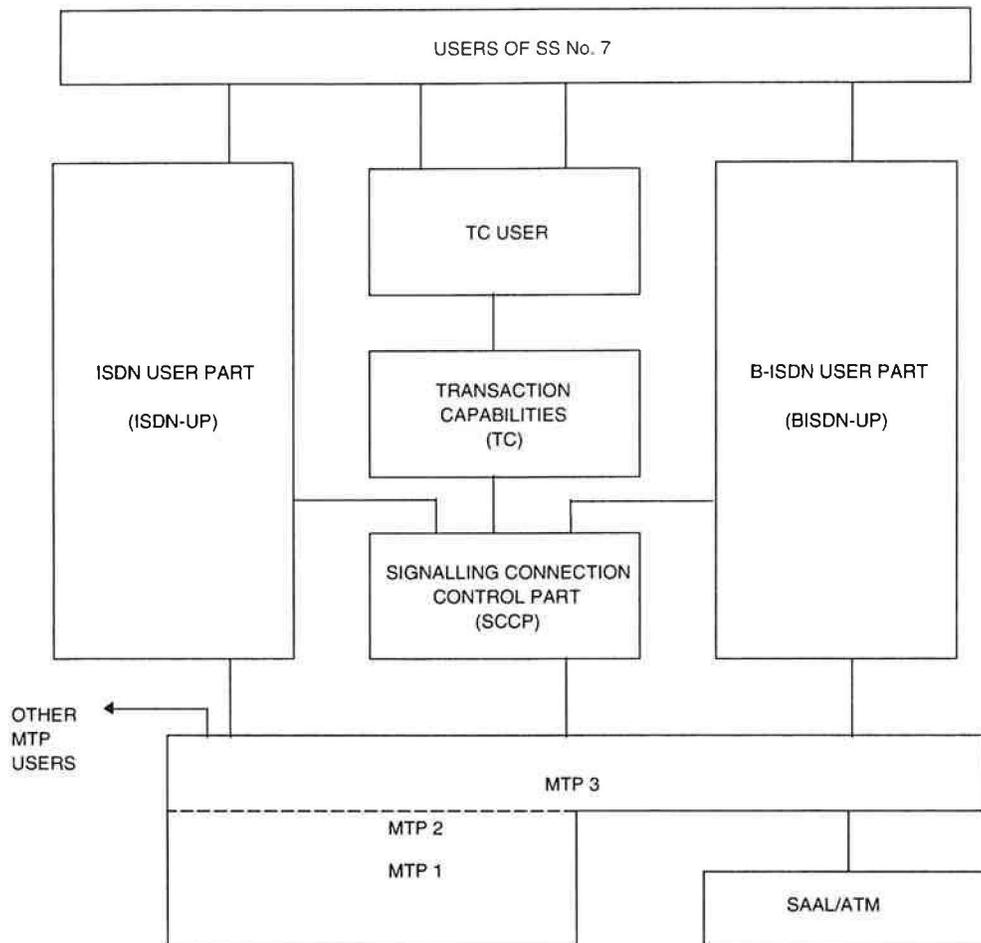


Figure 2/T1.110.1 - Architecture of SS No. 7

3.2 SS7 Architecture

3.2.1 General

Figure 2/T1.110.1 shows the Architecture of SS7 and illustrates the functional relationship between the various functional blocks of the SS7. Figure 5/T1.110.1 shows the relationship between SS7 levels and the OSI Reference Model Layers. This level/layer relationship is described in the following sections.

The initial specification of SS7 was based on circuit-related telephony control requirements. To meet these requirements, SS7 was specified in four functional levels, the Message Transfer Part comprising levels 1-3 (where levels 1 and 2 may be replaced with the SAAL and ATM), and the User Parts as level 4.

Figure 3/T1.110.1 shows the Functional Levels of SS7. As new requirements have emerged (e.g., for non-circuit related information transfer) SS7 has evolved to meet the needs of these new requirements. There has been a need to align certain elements in SS7 to the OSI 7 Layer Reference Model.

The result of this evolution is that Functional Levels and OSI layers co-exist in SS7. For example, the SCCP is a level 4 User Part in MTP terms, but also provides an OSI Network layer 3 service. Subsequent sections describe the various functional elements of SS7 in terms of levels and layers.

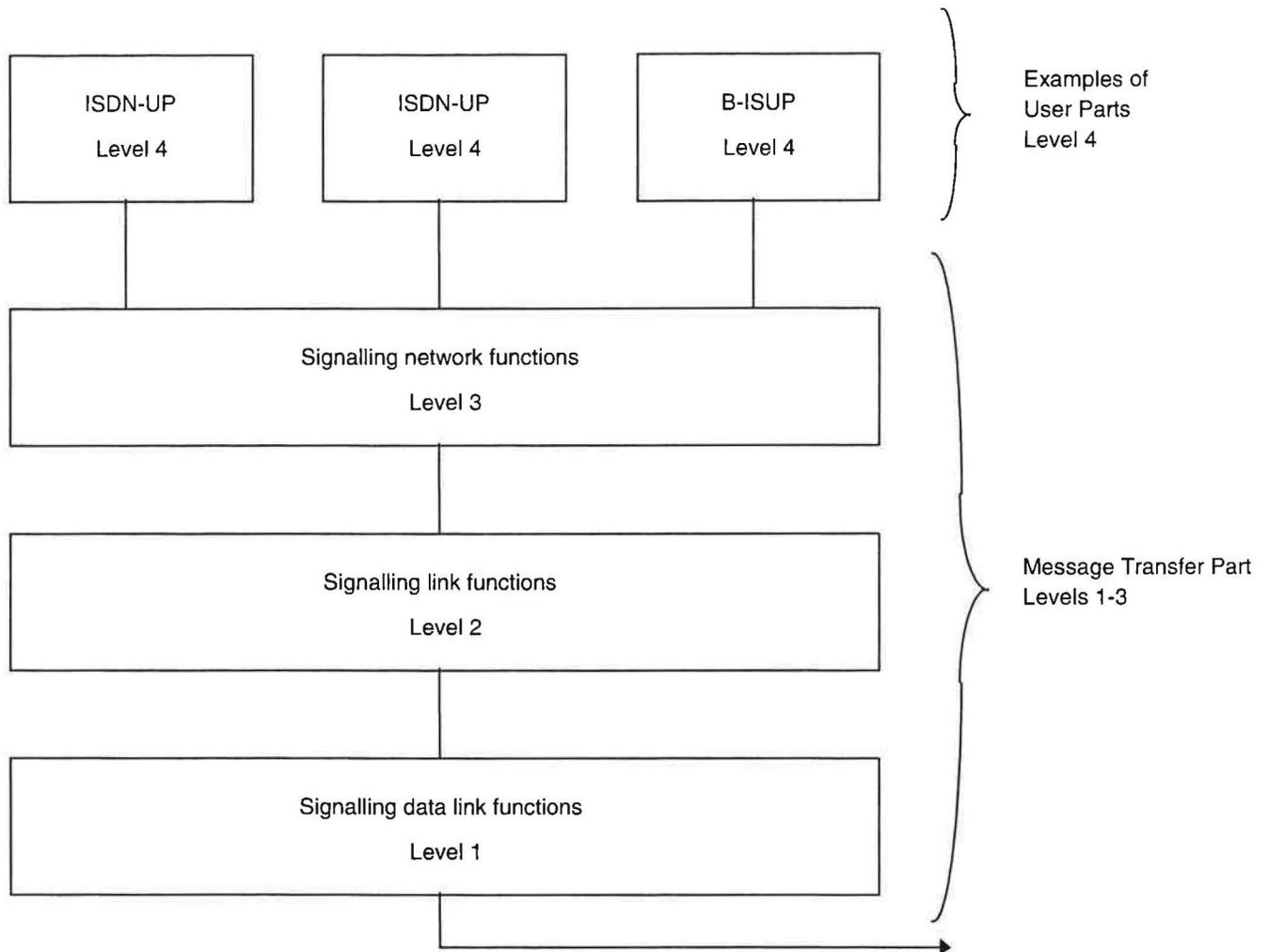


Figure 3/T1.110.1 - SS7 Functional Levels

It should be noted that the approach proposed for ISDN architecture is to define two orthogonal planes: User and Control, each of which has its own 7-layer protocol reference model.

From the perspective of an end user, the service provided by a telecommunications network may be regarded as a Network Layer Service (User Plane).

Within the telecommunications network, the techniques of the ISDN Protocol Reference Model are applied, and the 7-layer protocol structure of the OSI Model can also be used for inter-nodal communication to the end user.

3.2.2 Message Transfer Part (MTP) levels 1-3

An overview of the MTP is given in ANSI T1.111.1. The MTP is defined in ANSI T1.111. As noted below, the SAAL and ATM protocols may replace MTP levels 1 and 2. These protocols are defined in ANSI standards T1.627, T1.635, T1.636, T1.637, T1.640, T1.645, T1.646 and T1.652.

3.2.2.1 Signalling data link functions (level 1)

Level 1 defines the physical, electrical and functional characteristics of a signalling data link and the means to access it. The level 1 element provides a bearer for a signalling link.

In a digital environment, 56 or 64-kbit/s digital paths will normally be used for the signalling data link. The signalling data link may be accessed via a switching function, providing a potential for automatic reconfiguration of signalling links. Other types of data links, such as analogue links with modems, can also be used. When higher speeds are needed, 1.544 Mbit/s digital paths can be used for the signalling data link. Asynchronous Transfer Mode (ATM) may be used alternatively instead of MTP level 1 to provide the physical layer functions for SS7 signalling.

The detailed requirements for signalling data links are specified in chapter T1.111.2 of ANSI T1.111.

3.2.2.2 Signalling link functions (level 2)

Level 2 defines the functions and procedures for and relating to the transfer of signalling messages over one individual signalling data link. The level 2 functions, together with a level 1 signalling data link as a bearer, provide a signalling link for reliable transfer of signalling messages between two points.

The signalling link functions are optimized for 56 or 64 kbit/s operation. They are also optimized for 1.536 Mbit/s data rate links to accommodate the growth of SS7 traffic. For ATM based transmission, the signalling system is optimized for operation at 64 kbit/s and higher.

A signalling message delivered by the higher levels is transferred over the signalling link in variable length signal units. For proper operation of the signalling link, the signal unit comprises transfer control information in addition to the information content of the signalling message.

The detailed requirements for signalling functions are given in chapter T1.111.3 of ANSI T1.111.

3.2.2.3 Signalling network function (level 3)

Level 3 in principle defines those transport functions and procedures that are common to and independent of the operation of individual signalling links. These functions fall into two major categories:

- a) Signalling message handling functions. These are functions that, at the actual transfer of the message, direct the message to the proper signalling link or User Part.
- b) Signalling network management functions. These are functions that, on the basis of predetermined data and information about the status of the signalling network, control the current message routing and configuration of the signalling network facilities. In the event of changes in the status, they also control the reconfigurations and other actions to preserve or restore the normal message transfer capability.

The detailed requirements for signalling network functions are given in chapter T1.111.4 of ANSI T1.111.

If ATM-based signalling links are used in a network that also has MTP level 2-based signalling links, precautions must be taken to allow interworking between different signalling links using the two protocols.

3.2.3 Level 4: MTP User functions

Level 4 consists of the different User Parts. Each User Part defines the functions and procedures of the signalling system that are particular to a certain type of user of the system. The following entities are defined as User Parts in SS7.

3.2.3.1 Signalling Connection Control Part (SCCP)

The SCCP is defined in ANSI T1.112. This Specification defines the SCCP capabilities, layer interfaces to MTP and SCCP users, signalling messages, their encoding and signalling procedures, and cross-office performance. The SCCP provides additional functions to the Message Transfer Part to provide such connectionless and connection-oriented network services to transfer circuit-related and non-circuit-related signalling information.

The SCCP provides the means to:

- control logical signalling connections in a SS7 network;
- transfer Signalling Data Units across the SS7 network with or without the use of logical signalling connections.

SCCP provides a routing function that allows signalling messages to be routed to a signalling point based on, for example, dialed digits. This capability involves a translation function that translates the global title (e.g., dialed digits), into a signalling point code and a subsystem number.

SCCP also provides a management function, that controls the availability of the "subsystems," and broadcasts this information to other nodes in the network that have a need to know the subsystem status.

The combination of the MTP and the SCCP is called "Network Service Part" (NSP). The Network Service Part meets the requirements for layer 3 services as defined in the OSI-Reference Model, ITU-T Recommendation X.200.

ANSI T1.112 corresponds to ITU-T Q.711 through Q.714, and Q.716.

3.2.3.2 ISDN User Part (ISDN-UP)

The ISDN User Part is defined in ANSI T1.113. This Specification defines the ISDN network signalling messages, their encoding and signalling procedures and cross-office performance. This Specification deals with the basic service and some SS7-based services.

The ISDN-UP encompasses signalling function required to provide switched services and user facilities for voice and non-voice applications in the ISDN.

The ISDN-UP is also suited for application in:

- dedicated telephone networks and
- circuit-switched data networks,

which may be analogue, digital or mixed networks.

The ISDN-UP has an interface to the SCCP (which is also a level 4 User Part) to allow the ISDN-UP to use the SCCP for end-to-end signalling.

SS7-based services handled by the SS7 applications are described in ANSI T1.611. There are also ISDN supplementary services handled by ISDN applications. These services embody ISDN-UP signalling messages and procedures. In some cases these services include application protocol that uses TC and SCCP, as, for example, ISDN Call Forwarding (CF).

ANSI T1.113 corresponds to ITU-T Q.761 through Q.764, Q.766, and Q.730.

3.2.3.3 Transaction Capabilities

Transaction Capabilities is defined in ANSI T1.114. This Specification defines the Transaction Capabilities signalling messages, their encoding and signalling procedures.

Transaction Capabilities in the SS7 protocol are functions that control non-circuit-related information transfer between two or more signalling nodes via a signalling network. Transaction Capabilities in a SS7 network should be considered for use between:

1. Exchanges
2. Exchanges and network service centers (e.g., databases, service control points, Operation, Administration, Maintenance and Provisioning [OAM&P] centers).
3. Subscribers and network service centers (in conjunction with the subscriber access protocol, e.g., ITU-T Recommendation Q.931).

Although Transaction Capabilities in a SS7 network could be considered for use between subscribers, the standardization of subscriber-to-subscriber information content is outside the scope of SS7.

Furthermore, Transaction Capabilities in a SS7 network may interwork with a transaction-oriented information transfer originated in or destined for networks using other data communications protocols.

Transaction Capabilities provides a set of procedures that can be used for a variety of services, thereby avoiding the inefficiency of creating specific procedures tailored to a particular need. Thus, Transaction Capabilities provides a framework for a common approach to new services within a network as well as a framework for service architecture for cooperative internetwork services.

Wherever possible, procedures and formats for TC are based on existing ITU-T Recommendations. The tangible benefits of such an approach are rapid documentation, reduced standardization effort and faster and more widespread implementation (with resulting economies of scale and an open environment for suppliers and users).

3.2.3.4 Application Entities and Application Service Elements

In an OSI environment, communication between application processes is modeled by communication between "Application Entities (AEs)." An AE represents the communication functions of an application process. There may be multiple sets of OSI communication functions in an application process, so a single application process may be represented by multiple AEs. However, each AE is a set of communication capabilities whose components are "Application Service Elements." An Application Service Element (ASE) is a coherent set of integrated functions.

3.2.3.4.1 Application Entities in a SS7 Environment

Figure 4/T1.110.1 shows the relationships among Application Processes, Application Entities, and Application Service Elements.

An Application Process is considered to be a range of functions and features that supports a particular network requirement. For example, an application process in the context of SS7 provides the coordination across circuit-related and non-circuit-related protocols where required.

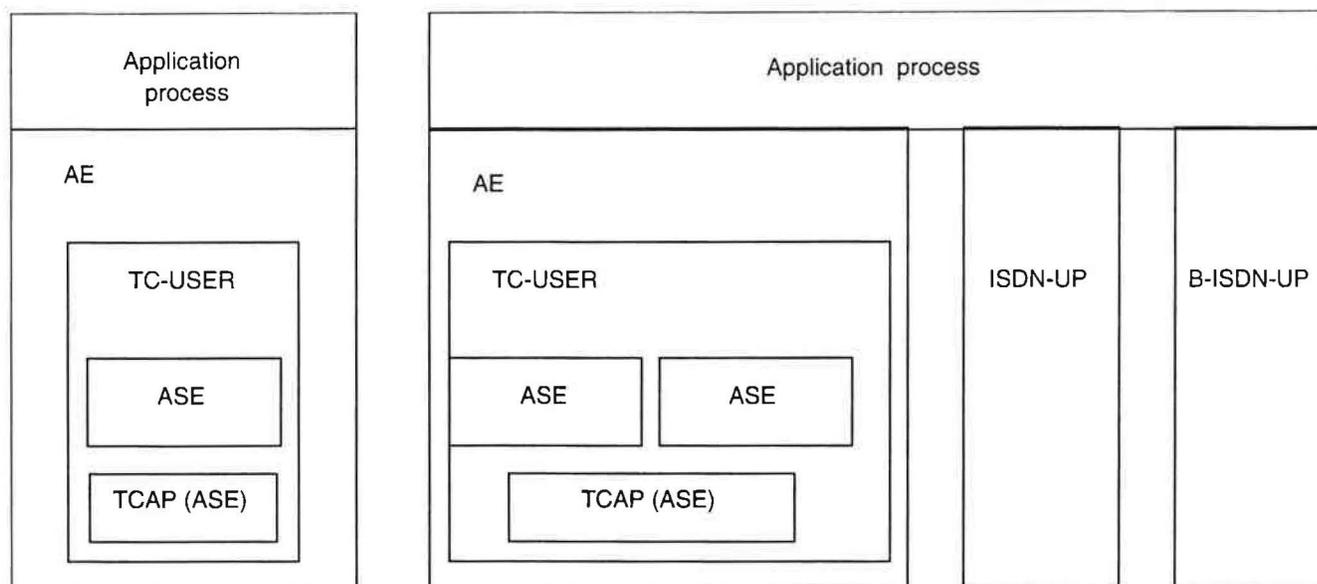
An Application Process can be considered as

- a) a coordinator of specific aspects of network operation (e.g., ISDN Call Control, Mobiles, OA&M);
- b) an individual service or supplementary service control function (e.g., CF).

In the SS7 context, the various functional elements of the signalling system provide the signalling protocols (information elements, messages, and procedures) necessary to support the service between nodes.

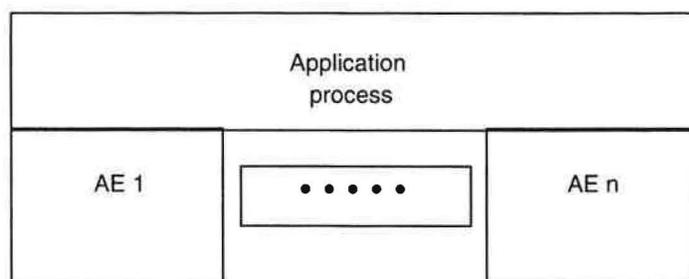
In a SS7 environment, AEs are the elements representing the communication functions of the Application Process, which are pertinent to inter-nodal communication using layer 7 application protocols.

The options for the relationship between an Application Process and the associated AEs and ASEs can take several forms at an SS7 signalling point. Some examples are shown in Figure 4/T1.110.1.



a) A TC-User containing one ASE

b) A TC-User containing several ASEs



c) An application may use more than one application entity

Figure 4/T1.110.1 - Example of the Relationship Between the Application Process and Associated AEs and ASEs

3.2.3.4.2 Application Service Elements in an SS7 Environment

Application Service Elements (ASEs) reside in the SS7 Architecture Model within layer 7 above TCAP. In the context of OSI, TCAP could also be considered to be an ASE.

OMAP has an Application Entity currently containing the TCAP ASE and one other ASE. Other ASEs are under study. OMAP is described further in clause 6.

The Mobile Application Part (MAP) is another example of an Application Entity (AE) (see Recommendation Q.1051).

An ASE can include a number of signalling procedures for a single service (e.g., CF) where this single service is the application.

Alternatively, an ASE can include a number of signalling procedures for any number of services or functions encompassed by an application (e.g., MAP, OMAP).

Thus, an ASE can define an individual service protocol (e.g., CF) or a complete application protocol (e.g., MAP).

An ASE can only communicate with a compatible peer ASE. The operations defined in an ASE may be either symmetrically invoked by each entity involved in the dialogue, or asymmetrically invoked by one entity only (i.e., on a "client/server" basis). An example of the former is a "look ahead if free" procedure; an example of the latter is a database inquiry.

3.2.3.4.3 Addressing for Application Entities (AEs)

The SCCP provides a mechanism for addressing "subsystems" using SubSystem Number (SSNs). The Application Entity is considered, in the connectionless mode, equivalent to an SCCP subsystem.

3.2.3.4.4 Management of AEs

The SCCP provides a mechanism for managing "subsystems" and signalling points and informing other nodes of relevant availability status.

3.2.3.5 B-ISDN User Part (B-ISDN-UP)

The B-ISDN User Part, which supports the signalling for ATM bearer services, is defined in ANSI T1.648. This specification defines the B-ISDN network signalling messages, their encoding, and signalling procedures. This specification deals with the basic service.

The B-ISDN-UP encompasses signalling functions required to provide switched services and user facilities for voice and non-voice applications in the B-ISDN.

The B-ISDN-UP is also suited for application in dedicated telephone and circuit-switched data networks.

The B-ISDN-UP has an interface to the SCCP (which is also a level 4 User Part) to allow the B-ISDN-UP to use the SCCP for end-to-end signalling.

ANSI T1.648 corresponds to ITU-T Recommendations Q.2761 through Q.2764. ANSI T1.665 corresponds to ITU-T Recommendation Q.2721.1.

4. OSI Layering and SS7

4.1 General

Evolution of the Signalling System No.7 architecture has been based on the Open Systems Interconnection (OSI) Reference Model.

The purpose of the Reference Model of Open Systems Interconnection for ITU-T Application (Recommendation X.200) is to provide a well-defined structure of modeling the interconnection and exchange of information between users in a communications system. This approach allows standardized procedures to be defined not only to provide an open systems interconnection between users over a single network, but also to permit interworking between networks to allow communication between users over several networks in tandem.

At present, OSI only considers connection-oriented protocols, that is, protocols which establish a logical connection before transferring data. In SS7, the ISDN-UP uses the SCCP connection-oriented protocol for connection-oriented network services. The SS7 Network Service Part (NSP) provides both connectionless and connection-oriented protocol.

The approach taken in the OSI reference model is to partition the model used to describe this interconnection and exchange information between users in a communications system into seven layers.

From the point of view of a particular layer, the lower layers provide a "transfer service" with specific features. The way in which the lower layers are realized is immaterial to the next higher layers. Correspondingly, the lower layers are not concerned with the meaning of the information coming from higher layers or the reasons for its transfer.

The characteristics of each layer are described below.

4.1.1 Physical Layer

The Physical Layer (layer 1) provides transparent transmission of a bit stream over a circuit built in some physical communications medium. It furnishes the interface to the physical media and is responsible for relaying bits (i.e., interconnects data-circuits). A 56 kbit/s link is assumed for the SS7 Physical Layer.

4.1.2 Data Link Layer

The Data Link Layer (layer 2) overcomes the limitations inherent in the physical circuits and allows errors in transmission to be detected and recovered, thereby masking deficiencies in transmission quality.

4.1.3 Network Layer

The Network Layer (layer 3) transfers data transparently by performing routing and relaying of data between end users. One or more of the sub-networks may interwork at the Network Layer to provide an end user to end user network service. A connectionless network provides for the transfer of data between end users, making no attempt to guarantee a relationship between two or more data messages from the same user.

4.1.4 Transport Layer

The Transport Layer (layer 4) provides end user to end user transfer optimizing the use of resources (i.e., network service) according to the type and character of the communication, and relieves the user of any concern for the details of transfer. The Transport Layer always operates end-to-end, enhancing the Network Layer when necessary to meet the quality of service objectives of the users.

4.1.5 Session Layer

The Session Layer (layer 5) coordinates the interaction within each association between communicating application processes. Full and half duplex dialogues are examples of possible Session Layer modes.

4.1.6 Presentation Layer

The Presentation Layer (layer 6) transforms the syntax of the data that is to be transferred into a form recognizable by the communicating application processes. For example, the Presentation Layer may convert a data stream from ASCII to EBCDIC.

4.1.7 Application Layer

The Application Layer (layer 7) specifies the nature of the communication required to satisfy the users' needs. This is the highest layer in the Model and so does not have a boundary with a higher layer. The Application Layer provides the sole means for the application processes to access the OSI environment.

4.2 Relationship between SS7 Layering and the OSI Model

Layers 1-3 comprise functions for the transportation of information from one location to another, possibly via a number of communication links in tandem. These functions provide the basis on which a communication network can be built.

- The SCCP provides, with the MTP, OSI layer services 1-3.

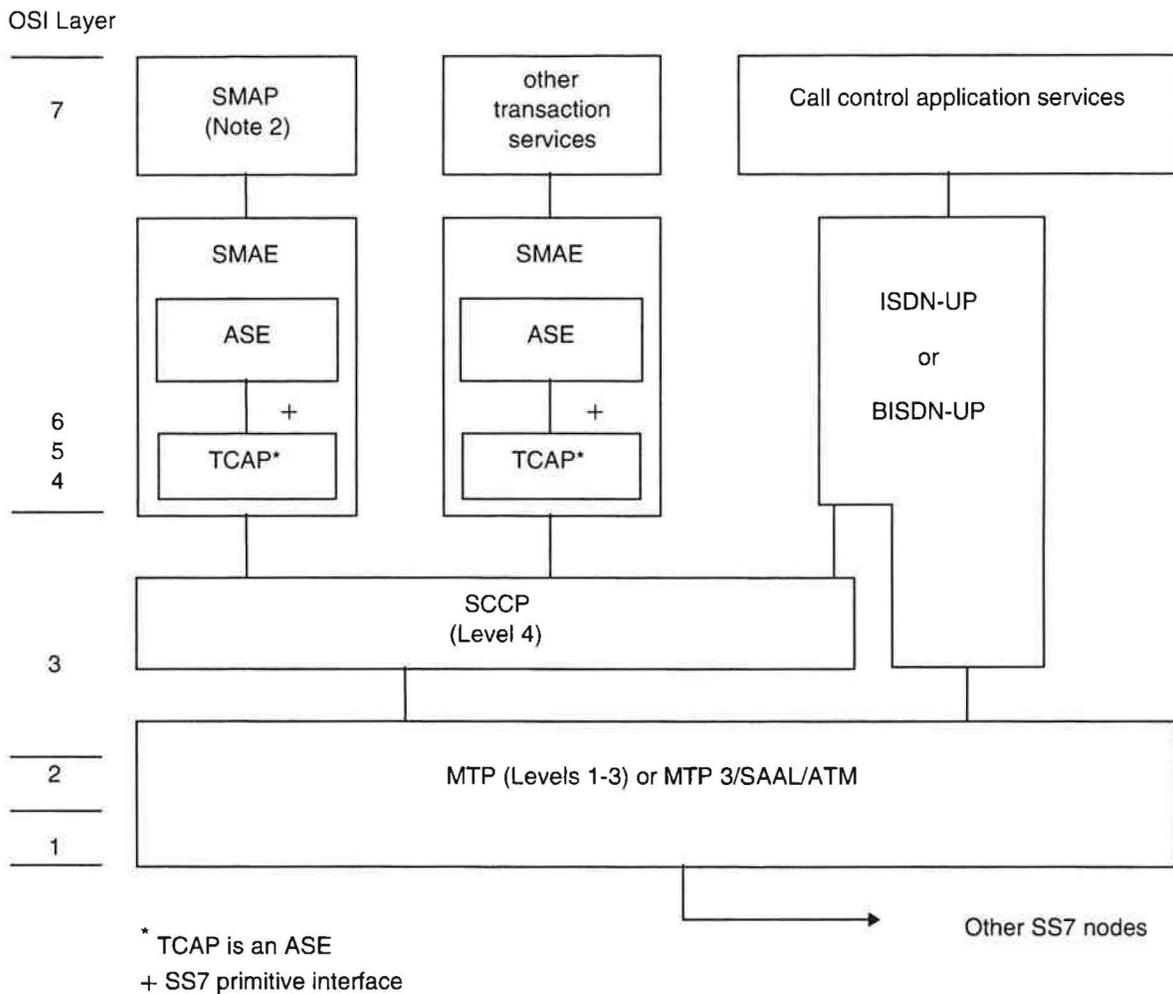
Layers 4-7 define functions relating to end-to-end communication. These layers are so defined that they are independent of the internal structure of the communication network.

- Transaction Capabilities provides layer 4-7 services.

Layer 7 represents the semantics of a communication, whereas layers 1-6 comprise the means by which the communication may be realized.

- Application Entities/Application Service Elements provide the appropriate Application Layer Protocols in layer 7.

Figure 5/T1.110.1 shows the relationship between SCCP, TC, and ASEs to the OSI 7 Layer Reference Model.



NOTE - The set of functions that collectively encompass systems management are known as the Systems Management Application Process (SMAP).

Figure 5/T1.110.1 -Relationship Between SS7 Functional Levels and OSI Layering

The aspect of the SMAP that is then involved with communication is the Systems Management Application Entity (SMAE). The SMAE is also known as the OMAP AE.

4.3 Primitive Interfaces between SS7 Functions

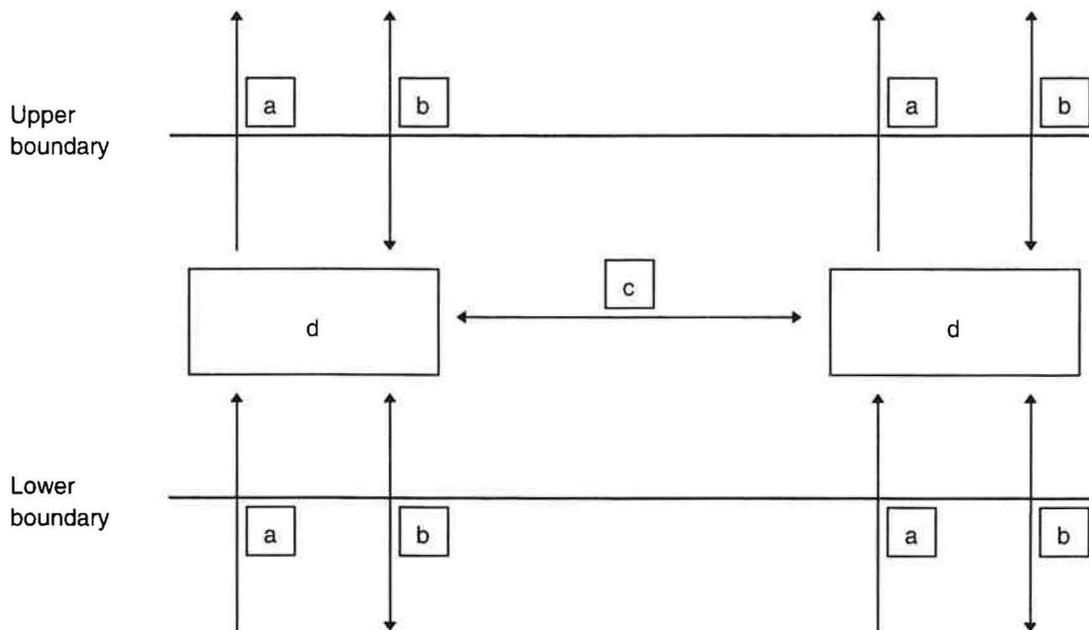
4.3.1 General

Interfaces between the functional elements of SS7 are specified using interface primitives. Primitive interface definition does not assume any specific implementation of a service.

4.3.2 OSI service primitives

Where the functional elements of SS7 are modeled on the OSI 7 layer reference model, e.g., SCCP, TC, service primitives are defined in line with Recommendation X.210.

In line with Recommendation X.210, Figure 6/T1.110.1 illustrates the relationship between the terms “service,” “boundary,” “service primitives,” “peer protocol,” and “peer entities.” The term “boundary” applies to boundaries between layers, as well as to boundaries between sublayers.



- a = service
- b = service primitive
- c = peer protocol
- d = peer entities

Figure 6/T1.110.1 - Types of Service Primitives

4.3.2.1 Service primitives

The user of primitives does not preclude any specific implementation of a service in terms of interface primitives.

A service primitive consists of a name and one or more parameters that are passed in the direction of service primitive.

The name of a service primitive contains three elements as defined in Recommendation X.210:

- a) An initial (or initials) which specifies the (sub)layer providing the service:
 - OM for the Operations Management primitives associated with OMAP;
 - TC for the TCAP Component sub-layer,

- TR for the TCAP Transaction sub-layer,
 - P, S, T, respectively for the Presentation, Session, and Transport layers in the ISP,
 - N for the Network Service Part (MTP + SCCP), as defined in chapter T1.112.1 of ANSI T1.112;
- b) a name that specifies the action to be performed;
- c) a type indicating the direction of the primitive flow. Four types of service primitives are identified (Figure 7/T1.110.1):
- request a primitive issued by a service user to invoke a service element.
 - indication a primitive issued by a service provider to advise that a service element has been invoked by the service user at the peer service access point or by the service provider.
 - response a primitive issued by the service user to complete at a particular service access point some service element whose invocation has been previously indicated at that service access point.
 - confirmation a primitive issued by a service provider to complete at a particular service access point some service element previously invoked by a request at that service access point.

Not all four types can be associated with all service names.

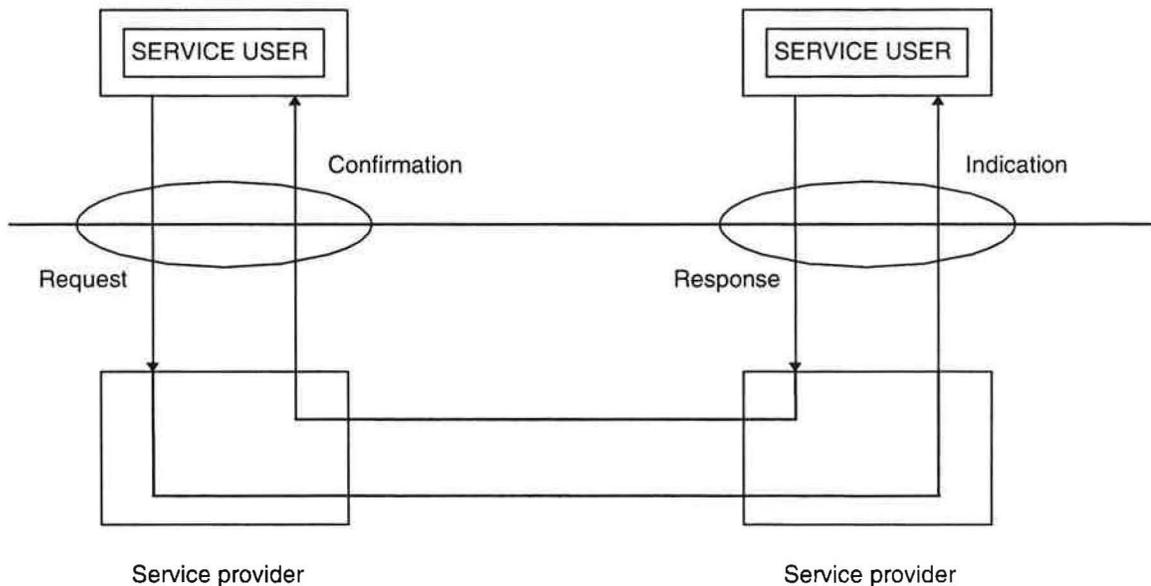


Figure 7/T1.110.1 - Types of Service Primitives

Figure 8/T1.110.1 provides an overview of the primitives used between the various functional elements of SS7.

The MTP primitives apply to all level 4 users of the MTP.

Similarly, the SCCP Management Primitive N-STATE, N-COORD, N-PCSTATE apply to all SCCP subsystems and AEs via TC.

The TC primitives between the ASE and TC provide control of connectionless TCAP transactions.

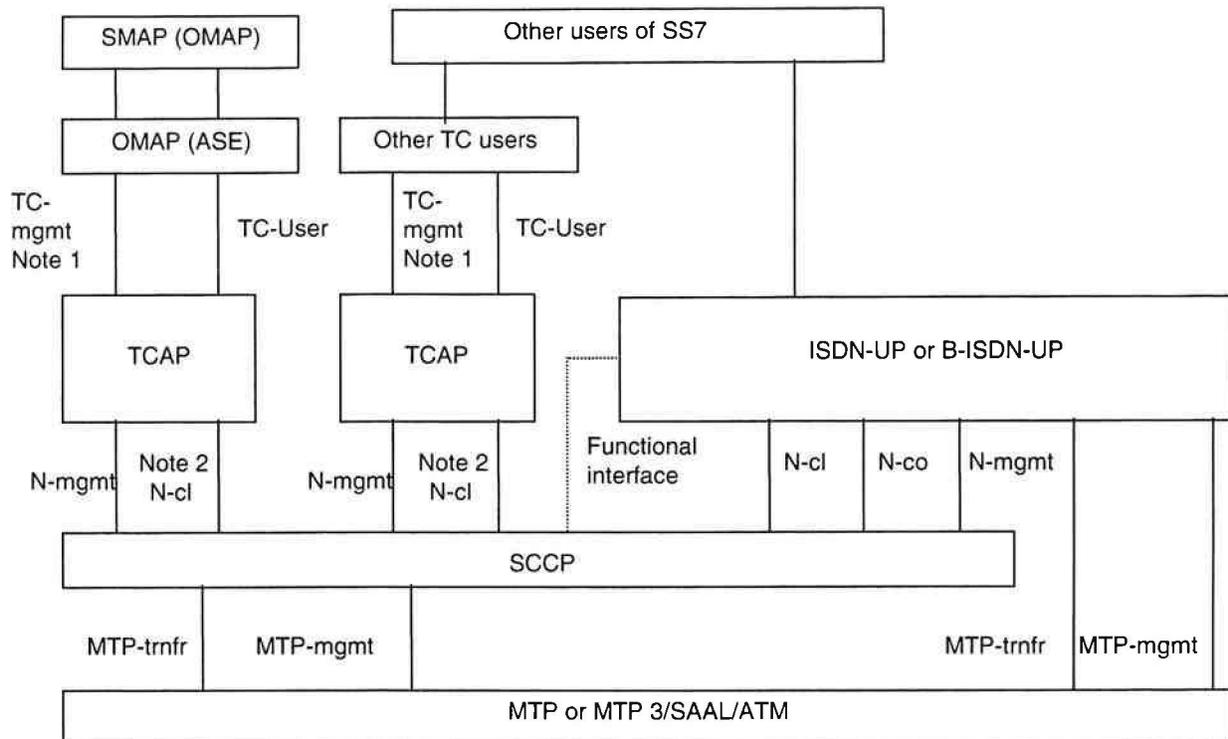


Figure 8/T1.110.1 - Overview of the primitives used between the functional elements of SS7

Key:

MTP-mgmt	MTP management primitives
MTP-trnfr	MTP primitives for message transfer
N-co	SCCP (Network Layer) connection oriented primitives
N-cl	SCCP (Network Layer) connectionless primitives
N-mgmt	SCCP (Network Layer) management primitives
Functional Interface	SCCP-ISUP interface for end to end signalling
TC-user	TC-User primitives for TCAP services
TC-mgmt	Management primitives for TC users.

Note 1: The handling of N-management primitives by TC is for further study.

Note 2: The handling of N-co primitives by TC is for further study.

5. Addressing

Addressing of SS7 messages has to be considered on a number of levels. For example, the MTP uses the destination point code to route the message to the appropriate signalling point. The ISUP and B-ISUP called party number field in the Initial Address Message is used to route the call to the appropriate called destination. The capabilities of the various SS7 addressing mechanisms is illustrated by the signalling message structure.

5.1 Signalling Message Structure

A signalling message is an assembly of information (defined at level 3 or 4) pertaining to a call, management transaction, etc., that is transferred as an entity by the message transfer function.

Each message contains service information including a service indicator identifying the source User Part and possibly additional information such as an indication whether the message relates to an international or national application of the User Part.

The signalling information of the message includes the actual user information, such as one or more telephone or data call control signals, management and maintenance information, etc., and information identifying the type and format of the message. It also includes a label that provides information enabling the message to be:

- routed by the level 3 functions and through a signalling network to its destination; and (This part of the label is known as the Routing label. This is shown in Figure 9/T1.110.1.)
- directed at the receiving User Part to the particular circuit, call, management or other transaction to which the message is related.

Further details are given in chapter T1.110.1, subclause 5.2.

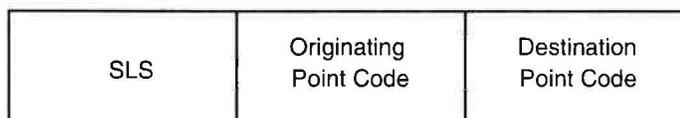


Figure 9/T1.110.1 - SS7 Routing Label

There are five types of message labels:

- type A for MTP management messages (The format defined in ITU-T Q.700 is *not applicable for the U.S.*);
- type B for TUP (*Not applicable for the U.S.*);
- type C for ISDN-UP (*circuit-related*) messages;
- type D for SCCP messages (*Also used for MTP3 management messages in the U.S.*),
- type E for B-ISDN-UP (*circuit-related*) messages.

These are shown in Figure 10/T1.110.1.

The circuit identification code is used as a label for circuit-related signalling messages, e.g., ISDN-UP. In the ISDN-UP, the Signalling Link Set (SLS) code is a separate octet from the circuit identification code.

The SS7 MTP signalling messages at level 2, which carry user information, are called Message Signal Units (MSUs). Figure 11/T1.110.1 shows the basic format of the MSU (refer also to T1.111.3), and the breakdown of the MSU's Signalling Information Field (SIF) when transporting circuit-related (ISDN-UP or B-ISDN-UP) messages and non-circuit-related (SCCP, TC based) messages. Further details are given on message formats in ANSI T1.111.4, T1.112.3, T1.113.3, T1.114.3, T1.114.5 and T1.648.3.

MTP Management Messages: Label Type A (The format defined in ITU-T Q.700 is not applicable for the U.S.)

TUP Management Messages: Label Type B (not applicable for the U.S.)

ISDN-UP Messages: Label Type C

Signalling Information	Circuit ID Code	SLS	Originating Point Code	Destination Point Code
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SCCP Messages: Label Type D (Also used for MTP3 management messages in the U.S.)

Signalling Information	SLS	Originating Point Code	Destination Point Code
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B-ISDN-UP Messages: Label Type E

Signalling Information	SLS	Originating Point Code	Destination Point Code
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Routing Label

Figure 10/T1.110.1 - SS7 Message Label Types

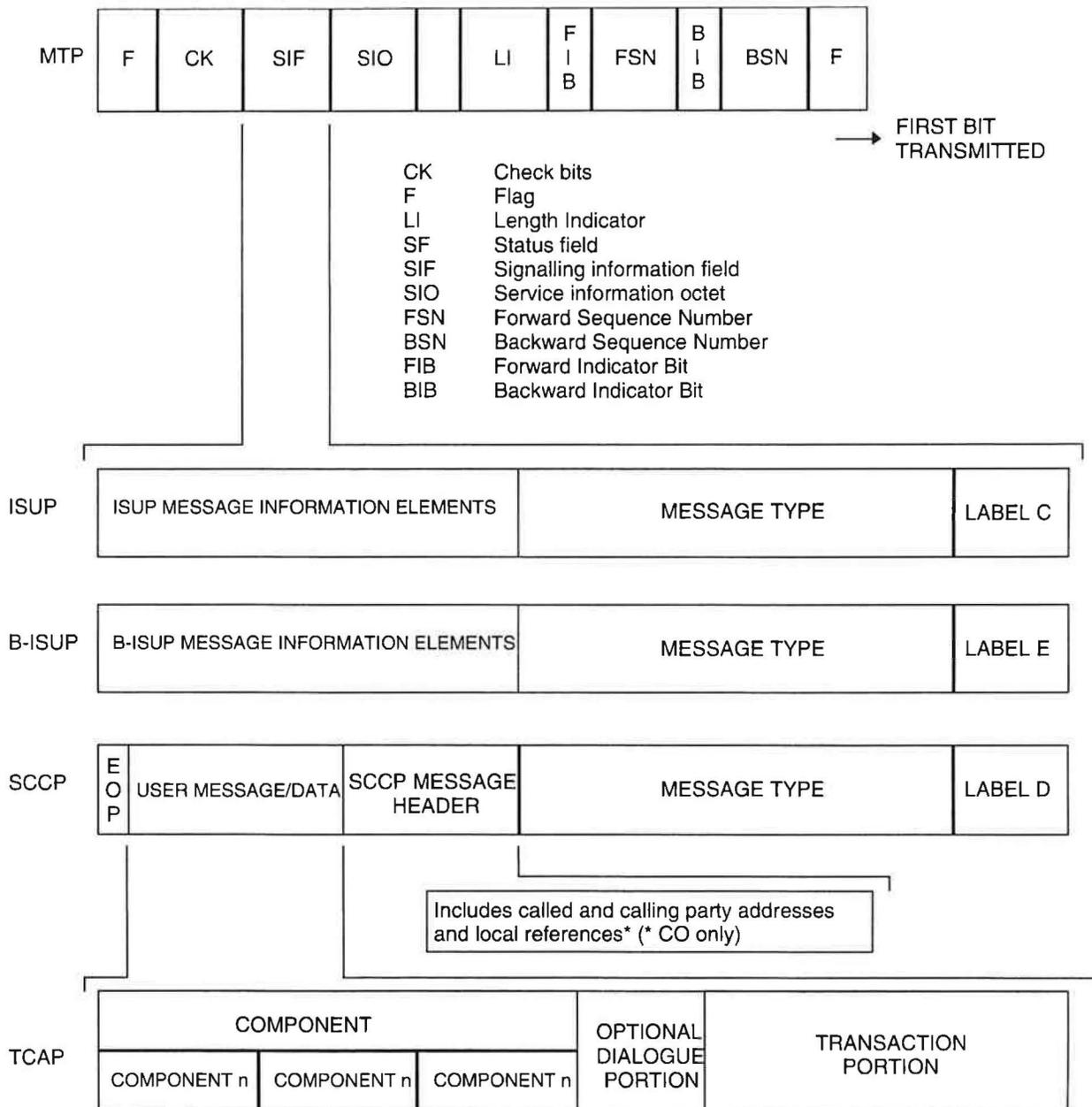


Figure 11/T1.110.1 - SS7 Signalling Message Structure

5.2 MTP Addressing

There is a two part addressing mechanism in the MTP. One part of the mechanism uses the point code that is incorporated in the routing label of every message signal unit, the other part of the mechanism makes use of the service indicator and network indicator within the service information octet (SIO). The point code is used for inter-node addressing and the SIO addresses signalling system users on an intra-node basis.

5.2.1 Point codes

Every signalling point (SP) and signalling transfer point (STP), when integrated in an SP will be allocated its own unique point code. This is used by the MTP routing function to direct outgoing messages towards their destination in the network as indicated by the inclusion of the appropriate point code in the routing label. This point code is known as the destination point code (DPC). The routing label also contains the point code of the SP originating the message signal unit, therefore, the combination of this originating point code (OPC) and DPC will determine the signalling relation (i.e., the network points between which MTP "User" information is exchanged). The DPC is used by the receiving SP discrimination function to determine whether the message is addressed to that SP or requires to be onward routed by means of the signal transfer capability.

The DPC will always be determined and inserted in the routing label by the level 4 MTP "User." This will also generally be the same for the OPC but it is possible that since the OPC might be constant it could be inserted by the MTP.

5.2.2 Service Indicator and Network Indicator

The 4-bit service indicator (SI) and 2-bit network indicator (NI) are included in the service information octet (SIO) and are used within an SP's distribution function to determine the "User" to which the incoming message should be delivered.

The SI will determine the "User," e.g., SCCP or ISUP, and the NI will determine which network is concerned, e.g., international or national.

The NI will also in conjunction with the OPC and DPC determine whether a national or international signalling relation and routing is involved.

The NI, together with the standard 24-bit point code, allows for a maximum of 16,777,216 point codes to be allocated in the North American signalling network. International signalling networks use a 14-bit point code.

5.3 SCCP Addressing

Addressing with the SCCP of SS7 makes use of three separate elements:

DPC

Global Title (GT)

Sub-System Number (SSN)

One, two or all of the elements may be present in the Called and Calling Party Address, the main options are:

GT DPC + SSN	When transferring SCCP messages
SSN GT SSN + GT	When receiving messages from MTP
DPC DPC + (SSN or GT or both) GT GT + SSN	When receiving message from connectionless or connection oriented control for SCCP Routing.

The form of address used will depend on the service, application and underlying network.

5.3.1 Global Title (GT)

The Global Title (GT) may be comprised of dialed digits or another form of address that will not be recognized in the SS7 network. Therefore, if the associated message requires routing over the SS7 network, translation is required.

Translation of the GT will result in a DPC and possibly a new SSN or new Global Title Address Information (GTAI). A field is included in the address indicator to identify the format of the global title.

5.3.2 Destination Point Code (DPC)

The DPC in an address requires no translation and is used to determine if the message is destined for that SP (incoming message) or if routing is required over the SS7 signalling network via the MTP. For outgoing messages this DPC should be inserted in the routing label.

5.3.3 SubSystem Number (SSN)

The SSN will identify a subsystem accessed via the SCCP within a node and may be a User Part, e.g., ISUP, SCCP management or an AE via TC.

When examination of the DPC in an incoming message has determined that the message is for that SP, examination of the SSN will identify the destined SCCP "User." The presence of an SSN without a DPC will also indicate a message that is addressed to that SP.

The SSN field has an initial capacity of 255 codes with an extension code for future requirements.

5.4 User Part Addressing

5.4.1 ISDN User Part addressing

The ISDN User Part address structure is capable of handling E.164 addresses in the calling and called number, and re-directing address information elements.

5.4.2 Signalling connection control part addresses

The SCCP is capable of handling E.164 (incorporating E.163), X.121, F.69, E.210, E.211, E.212, E.213, addresses, and the mobile hybrid E.214 address in the calling and called party address information elements.

The handling of OSI NSAP addresses in SCCP is for further study.

5.4.3 B-ISDN User Part addressing

The B-ISDN User Part is capable of handling E.164 addresses and ATM End System Addresses (e.g., DCC, ICD, E.164) in the calling and called number.

5.5 Labeling

A variety of methods to label signalling messages is used to allow the signalling system and users of the signalling system, to relate a received message to a particular call or transaction.

For circuit-related messages, (e.g., on a simple telephone call), the ISUP uses the circuit identification code (CIC) to label the message.

For certain ISUP procedures, call references are used to associate messages with calls.

For broadband circuit-related messages, the B-ISUP uses the signalling identifiers (SIDs) to label the message.

SCCP also uses local references on connection oriented protocols.

Transaction capabilities use transaction and invoke identities to associate transaction messages and components respectively.

6. Operations Administration and Maintenance

The overall organization of these specifications parallels that used in the equivalent ITU-T Recommendations. Thus chapters T1.116.0 through T1.116.6 of ANSI T1.116 correspond to ITU-T Recommendations Q.750 through Q.756.

6.1 Management

Management within SS7 is partitioned into two main areas:

- Signalling network management;
- Signalling system management.

6.1.1 Signalling network management

These are functions contained within the MTP and SCCP which, by means of automatic procedures, maintain the required signalling network performance (e.g., changeover of faulty links, forced re-routing, subsystem availability, etc.).

6.1.2 Signalling system management

This may be considered as the actions taken by the operator (or by an external automatic mechanism) to maintain the signalling system performance when problems are identified.

6.1.3 Signalling System No.7 and TMN

The Telecommunications Management Network (TMN) concept identifies SS7 to act as a data communications network (DCN) for some TMN functions. The protocols that will be needed for this purpose are intended to be defined as ASEs as part of OMAP. The relationship to TMN is provided.

6.1.4 Signalling System No. 7 and OSI management

The Management Model is consistent with the Open Systems Interconnection (OSI) Management Model.

6.2 Maintenance and Testing

The maintenance administration and management functions of the signalling system use the signalling system as a data carrying mechanism. When regarded in the data transport mode, however, any management or maintenance information is regarded as signalling traffic. Those functions having direct impact on SS7 are included in OMAP (ANSI T1.116).

Testing within Signalling System No.7 is:

- initiated automatically as a part of a signalling system management procedures (e.g., signalling route set test in MTP) or
- applied as a result of external activity, e.g., human-machine (MMI).

The first form is described in the appropriate ANSI T1.11n standard dealing with MTP or SCCP, etc. The second form includes some MMI initiated procedures (initiation of MRVT (ANSI T1.116)).

6.2.1 Operations Maintenance and Administration Part (OMAP)

ANSI T1.116 provides procedures and protocols related to operations and maintenance information. These procedures and protocols use TCAP (except the Circuit Validation Test, which is an ISDN-UP procedure) and are invoked by the system management application process (SMAP). ANSI T1.116 includes the following:

MTP Routing Verification Test (MRVT)

SCCP Routing Verification Test (SRVT)

Circuit Validation Test (CVT)

The protocol for the MRVT contained in ANSI T1.116 forms part of the OMAP AE that in turn uses the services provided by transaction capabilities.

ASEs needed to support the TMN functions are for further study.

6.2.2 Testing

(Not Specified for the US.) Note that some interconnection standards for SS7 are developed in Technical Subcommittee T1M1.

6.3 SS7 Measurements

ANSI T1.115 specifies the monitoring and measurements appropriate to the MTP and SCCP.

7 Signalling System Performance

The performance requirements of Signalling System No.7 must take account of the performance requirements of the services that are being supported. Each functional component of Signalling System No.7 has its performance criteria specified in a self-contained Specification.

7.1 Hypothetical Signalling Reference Connection (HSRC)

(Not Specified for the US.)

7.2 MTP

The MTP signalling performance requirements are specified in chapter T1.111.6 of ANSI T1.111. This Specification includes:

- the parameters route-set unavailability, MTP malfunction (loss of messages and mis-sequencing), and message transfer times;
- factors affecting performance, for example signalling traffic characteristics (e.g., loading potential, security, etc.) and parameters related to transmission characteristics (e.g., bit rates of signalling data links);
- those parameters that have greatest influence on the signalling network queuing delays for example, error control, security arrangements, failures and priorities.

It should be noted that management functions affect MTP performance.

7.3 SCCP

The SCCP signalling performance requirements are contained in chapter T1.112.5 of ANSI T1.112. Parameters identified are signal connection delays (establishment, unsolicited reset, reset and release signalling connection, reset and release failure probability, data message transmit delay, data message delay failure and error probability and SCCP unavailability).

It should be noted that management functions affect SCCP performance.

7.4 TUP

(Not Specified for the US.)

7.5 ISDN-UP

The ISDN-UP signalling performance requirements are contained in chapter T1.113.5 of ANSI T1.113.

Parameters contained in this Specification are cross office performance for ISDN-UP supported circuit connection control under normal and abnormal traffic loads. Also specified is the probability of failure of an ISDN call due to signalling function.

7.6 BISDN-UP

For further study.

8 Flow Control

Signalling System No.7 in common with other transport mechanisms, needs to limit the input of data when congestion onset is detected. Failure to do so can create overload situations. The nature of SS7 will lead to SP or STP overload congestion being spread through the signalling network if no action is taken. This will result in impaired signalling performance. In addition to signalling network congestion within a node, congestion will require action to prevent signalling performance from deteriorating. There is thus a need for flow control within the signalling system to maintain the required signalling performance.

8.1 Signalling Network Flow Control

This is achieved by incorporating a flow control mechanism in the MTP or in the SAAL. On detection of congestion, MTP "Users" are informed by the means of a special primitive; the "User" should then reduce signalling traffic towards the congested part of the network. If the User is at a remote SP, the information is carried across the network in an appropriate signalling network management message.

8.2 Signalling Node (Congestion) Flow Control

In addition to network congestion, nodal congestion also requires the remedial action of flow control to prevent the signalling performance from being impaired. Nodal congestion can occur both within the MTP and the MTP "User."

8.2.1 MTP nodal flow control

An activity similar to that used to combat signalling network congestion is provided. That is, on detection, the User is informed so that traffic can be reduced.

8.2.2 'User' flow control

As well as taking action to reduce MTP congestion, mechanisms are required within the User to detect the onset of congestion and to take appropriate action.

8.3 Automatic Congestion Control

The ISUP and B-ISUP provide signalling procedures that aim to reduce the new calls offered to an exchange that is experiencing processor overload.

Automatic congestion control provides the means to inform adjacent exchanges of the current workload, and to request that only priority calls are offered to the exchange experiencing overload.

9 Specification Guide

9.1 Support Information

Chapters T1.110.2 through T1.110.4 cover the glossary of new terms and abbreviations used throughout this document and the annotation rules used in producing this specification.

9.2 Message Transfer Part (MTP)

ANSI T1.111 describes the Message Transfer Part of SS7. Specifically, Chapter T1.111.1 describes the overall MTP, Chapter T1.111.2 describes the Physical Layer (level 1), Chapter T1.111.3 describes the Link Layer (level 2), Chapter T1.111.4 describes the connectionless Network Layer (level 3), Chapter T1.111.5 describes the signalling network structure, Chapter T1.111.6 describes the performance of the MTP, Chapter T1.111.7 describes MTP testing, and Chapter T1.111.8 describes the numbering scheme of signalling point codes.

9.3 SAAL/ATM

ANSI T1.640 describes the Broadband ISDN Network Node Interfaces and Inter Network Interfaces – Rates and Formats Specifications. ANSI T1.646 describes the Broadband ISDN and DS1/ATM User Network Interfaces (Physical Layer Specification). ANSI T1.627 describes the Broadband ISDN - ATM Layer Functionality and Specification. ANSI T1.636 provides an overview of the Signalling ATM Adaptation Layer (SAAL). ANSI T1.635 describes the ATM Adaptation Layer Type 5 Common Part functions and specifications. ANSI T1.637 describes the Signalling ATM Adaptation Layer – Service Specific Connection Oriented Protocol (SSCOP) and the Service Specific Coordination Function for Support of Signalling at the Network Node Interface (SSCF at the NNI). ANSI T1.652 describes the Signalling ATM Adaptation Layer – Layer Management for the SAAL at the NNI.

9.4 Signalling Connection Control Part (SCCP)

ANSI T1.112 describes the Signalling Connection Control Part of SS7. Specifically, chapter T1.112.1 describes the overall part, chapter T1.112.2 defines the individual messages, chapter T1.112.3 identifies the message encoding, chapter T1.112.4 specifies the procedures, and chapter T1.112.5 describes the performance of the SCCP.

9.5 Integrated Services Digital Network (ISDN) User Part

ANSI T1.113 describes the circuit control for the ISDN. It begins with the overall description in chapter T1.113.1 and continues with chapter T1.113.2 on messages, chapter T1.113.3 on encoding, chapter T1.113.4 on procedures, and chapter T1.113.5 on performance.

9.6 Transaction Capabilities

ANSI T1.114 covers the Transaction Capabilities Part. Chapters T1.114.1 through T1.114.5 concern overall description, messages, encoding, procedures, and operations, parameters and error codes, respectively.

9.7 Monitoring and Measurements of SS7

ANSI T1.115 specifies the monitoring and measurements of Signalling System No.7 (SS7). It covers those for the MTP, the SCCP, the ISDN-UP and the TC.

9.8 Operations, Maintenance and Administration Part (OMAP)

ANSI T1.116 specifies the protocols related to SS7 operations, administration and maintenance (OAM) information.

9.9 Broadband Integrated Services Digital Network (B-ISDN) User Part

ANSI T1.648 describes the ATM connection control for the Capability Set 1 B-ISDN signalling. It begins with the overall description in chapter T1.648.1 and continues with chapter T1.648.2 on messages, chapter T1.648.3 on encoding, and chapter T1.648.4 on signalling procedures. ANSI T1.665 provides an overview of the capabilities of the ANSI Broadband ISDN Network Node Interface (B-ISDN NNI) for the Broadband ISDN Signalling Capability Set 2, Step 1.

Chapter T1.110.2

Glossary

Chapter T1.110.2

Glossary

accessibility (referring to point code). Local MTP can send a message to the MTP at the remote signalling point.

active signalling link. A signalling link that has successfully completed the initial alignment procedures and carries (or is ready to carry) signalling traffic.

address. A name that indicates the source or destination of an intended instance of communication.

adjacent signalling points. Two signalling points that are directly interconnected by (a) signalling link(s).

alignment error rate monitoring. A procedure by which the error rate of a signalling link is measured during the initial alignment.

alternative routing (of signalling). The routing of a given signalling traffic flow in case of failures affecting the signalling link(s), or routes, involved in the normal routing of that signalling traffic flow.

analogue signalling data link. The data link that provides an interface to signalling terminals and is made up of voice-frequency analogue transmission channels and modems.

application. The set of a user's requirements.

application layer. The highest layer (Layer 7) of the Open Systems Interconnection (OSI) protocol model and specifies the nature of the communication required to satisfy the user's needs.

application service part. The part that includes the presentation level, session level and transport level of the SS7 protocol.

associated mode (of signalling). The mode in which messages for a signalling relation involving two adjacent signalling points are conveyed over a directly interconnecting signalling link.

availability (referring to point code and user part). Local MTP can send a message to the remote signalling point and the remote MTP can deliver the message to the user part.

asynchronous transfer mode. A transmission of information based on cells transmitted asynchronously instead of SS7 messages transmitted over a synchronous medium.

backward indicator bit. A bit in a signal unit that requests, by its status change, retransmission at the remote end when a signal unit is received out of sequence.

backward sequence number. A field in a signal unit that was sent, which contains the forward sequence number of a correctly received signal unit being acknowledged.

basic (error correction) method. A noncompelled, positive or negative acknowledgment, retransmission error control system.

broadband integrated digital network. A broadband network in which connections established by digital switching are used for the transmission of digital signals.

broadband integrated services digital network. A broadband integrated digital network in which the same digital switches and digital paths are used to establish connections for different services, for example, telephony and data.

changeback. The procedure of transferring signalling traffic from one or more alternative signalling links back to a signalling link that has become available. (See *Changeover*)

changeback code. A field in the signalling network management messages used in the changeback procedure; it is used to discriminate messages relating to different changeback procedures performed at the same time towards the same signalling link.

changeover. The procedure of transferring signalling traffic from one signalling link to one or more different signalling links, when the link in use fails or is required to be cleared of traffic.

check bit. A bit associated with a character or block for the purpose of checking the absence of error within the character or block.

check loop. A device that is attached to interconnect the Go and Return paths of a circuit at the incoming end of a circuit to permit the outgoing end to make a continuity check on a loop basis.

circuit identification code. Information identifying a circuit between a pair of exchanges, for which signalling is being performed (14 bits in the ISDN User Part).

class of service. A set of services provided by the SCCP and offered to the user of the SCCP.

cluster. A set of signalling points that are identifiable as a group within the signalling point code address space.

combined link set. A load-sharing collection of one or more link sets is called a combined link set.

common channel signalling. A signalling method in which a single channel conveys, by means of labeled messages, signalling information relating to a multiplicity of circuits or calls and other information, such as that used for network management.

common channel signalling network. A network consisting of two or more signalling points and connecting common channel signalling links that are administered in common.

component. The portion of the TCAP message that identifies the component type, provides correlation between components, specifies operations to be performed and contains the parameters relevant to that operation.

connection identification. A number that identifies unambiguously a certain connection at the interface between the SCCP and a user function.

connection section. A section of an SCCP connection between the endpoint and such type of intermediate point at which a coupling has to be provided between two adjacent sections.

connection-oriented network service. A network service that establishes logical connections between end users before transferring information

connectionless network service. A network service that transfers information between end users without establishing a logical connection or virtual circuit.

continuity check. A check made to a circuit or circuits in a connection to verify that an acceptable path (for transmission of data, speech, and the like) exists.

continuity check transponder. A device that is used to interconnect the Go and Return paths of a circuit at the incoming end which on detection of a check tone transmits another check tone to permit a continuity checking of a 2-wire circuit.

controlled rerouting. A procedure of transferring in a controlled way, signalling traffic from an alternative signalling route to the normal signalling route, when this has become available.

cross-office check. A check made across the exchange to verify that an acceptable speech path exists.

data link layer. The layer (Layer 2) that allows errors in transmission on the signalling data link to be detected and recovered.

dialogue. The optional portion of the TCAP message that identifies version, application context and security.

digital signalling data link. The data link that provides an interface to signalling terminals and is made up of digital transmission channels and digital switches or their terminating equipment.

dual seizure. The condition which occurs when in bothway operation two exchanges attempt to seize the same circuit at approximately the same time.

emergency changeover. A modified changeover procedure to be used whenever the normal one cannot be accomplished (i.e., in case of some failures in the signalling terminal equipment or in case of inaccessibility between the two involved signalling points).

end-to-end signalling. The capability to transfer signalling information directly between end points of a built-up circuit switched connection or between signalling points that are not interconnected by a circuit-switched connection.

(N)-entity. A set of functions invoked by a given layer for an instance of intersystems communication in which that system is involved. An entity may be partitioned into several subentities. For each instance of intersystems communications, the set of functions invoked will be a part or all of the functional capability of the given system within the layer in accordance with the functionality required for that instance of intersystem communication.

error burst. A group of bits in which two successive erroneous bits are always separated by less than a given number (x) of correct bits. The number, x , should be specified when describing an error burst.

NOTE -The last erroneous bit in a burst and the first erroneous bit in the following burst are accordingly separated by x correct bits or more.

fill-in signal unit. A signal unit containing only error control and delimitation information, which is transmitted when there are no message signal units or link status units to be transmitted.

flag. The unique pattern (01111110) on the signalling data link used to delimit a signal unit.

forced rerouting. A procedure of transferring signalling traffic from one signalling route to another, when the signalling route in use fails or is required to be cleared of traffic.

forward indicator bit. A bit in a signal unit that indicates the start of a retransmission cycle.

forward sequence number. A field in a signal unit used to identify the transmitted message signal units.

function. A logical object that accepts one or more inputs (arguments) and produces a single output (value) uniquely determined by the combination of the inputs and the formal specification of the function.

global title. A collection of fields (e.g., translation type, and global title address information (GTAI)) that define a service (or AE) address that does not explicitly contain information that would allow routing in the signalling network. The SCCP global title translation function is required to derive an SS7-routable address. GTAI is service-specific information, such as customer-dialed digits or subscriber identification number.

inactive signalling link. A signalling link that has been deactivated and cannot therefore carry signalling traffic.

initial alignment. A procedure by which a signalling link becomes able to carry signalling traffic either for the first time or after a failure has occurred.

initial signal unit alignment. Signal unit alignment applicable to the activation and to the restoration of the link.

integrated digital network. A network in which connections established by digital switching are used for the transmission of digital signals.

integrated services digital network. An integrated digital network in which the same digital switches and digital paths are used to establish connections for different services, for example, telephony, data.

interruption control. A system that monitors a pilot for interruptions on FDM systems and that transmits an indication to the switching equipment.

invoke component. A type of TCAP component that requests that an operation be performed at the receiving node.

label. Information within a signalling message used to identify the particular circuit, call, or management transaction to which the message is related.

layer. A group of one or more entities contained within an upper and lower logical boundary. Layer N has boundaries to the layer $(N+1)$ and to the layer $(N-1)$.

layer interface. The boundary between two adjacent layers in the model.

layer service. A capability of the (M) layer and the layers beneath it, which is provided to $(N+1)$ layer entities, at the boundary between the (M) layer and the $(N-1)$ layer.

layer service elements. An indivisible component of the layer service made visible to the service user via layer service primitives.

layer service primitives. Layer service primitives are a means for specifying in detail the adjacent layer interactions.

length indicator. A six-bit field that differentiates between message signal units, link status signal units, and fill-in signal units, and in the case that its binary value is less than 63 indicates the length of a signal unit.

link state control. Coordinates functions of the signalling link including signal unit delimitation, signal unit alignment, error detection, error correction, initial alignment, signalling link error monitoring, and flow control.

link status signal unit. A signal unit that contains status information about the signalling link in which it is transmitted.

load sharing (general). A process by which signalling traffic is distributed over two or more signalling or message routes, in view of traffic equalization or security.

local reference. A local number, unambiguously identifying an SCCP connection within one SCCP entity.

long-term bit error rate. Bit error rate measured over a sufficiently long period of time (e.g., one month).

management inhibit. A procedure included in signalling traffic management used to keep a signalling link unavailable to signalling traffic generated by the user part, except for test and maintenance traffic.

mandatory fixed part. Part of a message that contains those parameters that are mandatory and of fixed length for a particular message type.

mandatory variable part. Part of a message that contains mandatory parameters of variable length.

medium-term bit error rate. Bit error rate that can be encountered for relatively short time periods (e.g., some minutes, due to temporary malfunctions of, for example, transmission equipment).

message signal unit. A signal unit containing a service information octet and a signalling information field.

message transfer part. The functional part of a common channel signalling system that transfers signalling messages as required by all the users, and that performs the necessary subsidiary functions, for example, error control and signalling security (Levels 1,2, and 3 of SS7).

message type code. The mandatory one-octet field that uniquely defines the function and format of each ISDN user-part message.

network address. The signalling point code, containing for U.S. national networks, the network identification, network cluster, and network cluster member fields (24 bits).

network cluster. The field in the U. S. signalling point code structure that identifies groups of signalling points and individual STPs of a signalling network.

network cluster member. The field in the U. S. signalling point code structure that identifies individual signalling points within a cluster.

network identification. The field in the U. S. signalling point code structure that identifies signalling networks.

network indicator. The part of the subservice field within the service information octet that may be used to discriminate between national and international signalling messages.

network layer. The layer (Layer 3) that transfers data transparently by performing routing and relaying of data between end users.

network service part. The combination of the Message Transfer Part and the Signalling Connection Control Part.

no.7 exchange. An exchange utilizing SS7.

nonassociated mode (of signalling). The mode in which messages for a signalling relation involving two (nonadjacent) signalling points are conveyed, between those signalling points, over two or more signalling links in tandem passing through one or more signalling transfer points.

normal routing (of signalling). The routing of a given signalling traffic flow in normal conditions (i.e., in the absence of failures).

optional part. Part of a message that contains parameters that may or may not occur in any particular message type.

peer entities. Entities in the same layer but in different systems (nodes) that must exchange information to achieve a common objective.

peer protocol. A formal language used by peer entities to exchange user data.

physical layer. The layer (Layer 1) that provides transparent transmission of a bit stream over a circuit built from some physical communications medium.

pointer. A single octet that indicates the beginning of each mandatory variable parameter and optional part.

presentation layer. The layer (Layer 6) that transforms the syntax of the data to be transferred into a form recognizable by the communication application processes.

preventive cyclic retransmission (error control) method. A noncompelled, positive-acknowledgment, cyclic retransmission, forward-error-correction system.

primitives. The set of commands and their respective responses associated with the services requested between adjacent levels.

processor outage. A situation in which a signalling link becomes unavailable, due to factors at a functional level higher than level 2. This may be because of, for example, a central processor failure. It may also be due to a manually initiated blocking of an individual signalling link.

quasi-associated mode (of signalling). A nonassociated mode (of signalling) in which the (signalling) message route is determined basically, for each signalling message, by information contained in this message (namely, in its routing label) and is fixed in normal operation.

random errors. Errors distributed over the digital signal so that they can be considered statistically independent from each other.

retransmission buffer. Storage in the signalling link control for signal units transmitted but not positively acknowledged.

retrieval. The process of transferring all those messages in the retransmission buffer of a signalling link which have not yet been positively acknowledged, to the transmission buffers of alternative signalling links.

routing label. The part of the message label that is used for message routing in the signalling network. It includes the destination point code, the originating point code, and the signalling link selection field.

service indicator. Information within a signalling message identifying the user to which the message belongs.

service information (octet). Eight bits, contained in a message signal unit, comprising the service indicator and the sub-service field.

session layer. The layer (Layer 5) that coordinates the interaction with each association between communicating application processes.

signal unit. A group of bits forming a separately transferable entity used to convey information on a signalling link.

signal unit alignment. The alignment that exists when flags are received at intervals that correspond to integral numbers of octets and that fall within certain upper and lower limits.

signal unit error rate monitoring. A procedure by which the error rate of an active signalling link is measured on the basis of a count of correctly checking and erroneous signal units.

signal unit sequence control. Procedures used at Level 2 to ensure that message signal units are transported in sequence, without loss or duplication, over a particular signalling link.

signalling ATM adaptation layer. A signalling mode for SS7 level 2 that uses ATM instead of the synchronous transmission medium.

signalling connection control part (SCCP). This part provides additional functions to the MTP to cater for both connectionless as well as connection-oriented network services and to achieve an OSI-compatible network service.

signalling end point. A signalling point with the ability to source or sink Network Service Part user data and considered exclusively from the viewpoint of the source or sink.

signalling information. All information transferred over SS7 using its protocol.

signaling information (field). The bits of a message signal unit that carry information particular to a certain user transaction and always contain a label.

signalling link. A transmission means that consists of a signalling data link and its transfer control functions, used for reliable transfer of a signalling message.

signalling link activation. The process of making a signalling link ready to carry signalling traffic.

signalling link blocking. An event that causes the unavailability of a signalling link typically consisting in a "processor outage" condition at one end of that signalling link.

signalling link code. A field with certain signalling network management messages, which indicates the particular signalling link to which the message refers among those interconnecting the two involved signalling points.

signalling link deactivation. The procedure by which a signalling link is taken out of service.

signalling link error monitoring. Error monitoring comprises two functions: initial alignment error rate monitoring and signal unit error rate monitoring.

signalling link failure. An event that causes the unavailability of a signalling link, typically consisting in a failure in signalling terminal equipment or in the signalling data link.

(signalling) link group. A set of signalling links directly connecting two signalling points and having the same physical characteristics (bit rate, propagation delay, and the like).

signalling link management functions. Functions that control and take actions, when required, to preserve the integrity of locally connected signalling links, (e.g., by reconfiguration of the signalling link sets).

signalling link restoration. An event that consists in the completion of the initial alignment procedure on a signalling link following the removal of the previous causes of failure; if no other causes of unavailability exist (i.e., a signalling link blocked condition), then the signalling link becomes available.

signalling link selection field. A field of the routing label that is typically used by the message routing function to perform load sharing among different signalling links or link sets.

(signalling) link set. A set of signalling link(s) directly connecting two signalling points.

signalling link unblocking. An event consisting in the removal of the previous causes of signalling link blocking; if no other causes of unavailability exist (i.e., a signalling link failed condition), then the signalling link becomes available.

signalling message. An assembly of signalling information that pertains to a call, management transaction and the like and that is transferred as an entity.

(signalling) message discrimination. The process that decides, for each incoming message, whether the signalling point is a destination point or if it should act as signalling transfer point for that message and accordingly, whether the message should be handed to (signalling) message distribution or to (signalling) message routing functions.

(signalling) message distribution. The process of determining, upon receipt of a signalling message at its destination point, to which User Part the signalling message is to be delivered.

(signalling) message handling functions. Functions that, at the actual transfer of a message, direct the message to the proper signalling link or User Part.

(signalling) message route. The signalling link or consecutive links connected in tandem that are used to convey a signalling message from an originating point to its destination point.

(signalling) message routing. The process for selecting, for each signalling message to be sent, the signalling link to be used.

signalling network. A network used for signalling by one or more users and consisting of signalling points and connecting signalling links.

signalling network functions. The functions that are performed by the Message Transfer Part at level 3 and are common to, and independent of, the operation of individual signalling links. They include the signalling message handling functions and the signalling network management functions.

signalling network management functions. Functions that, on the basis of predetermined data and information about the status of the signalling network, control the current message routing and configuration of signalling network facilities.

signalling point. A node in a signalling network that either originates and receives signalling messages, or transfers signalling messages from one signalling link to another, or both.

(signalling) point code. A binary code uniquely identifying a signalling point in a signalling network. This code is used, according to its position in the label, either as destination point code or as originating point code.

signalling relation. A relation between two signalling points involving the possibility of information interchange between corresponding User Part functions.

signalling route. A predetermined path described by a succession of signalling points that may be traversed by signalling messages directed by a signaling point towards a specific destination point.

signalling route management functions. Functions that transfer information about changes in the availability of signalling routes in the signalling network.

signalling route set. A complete set of signalling routes from a signalling point towards a specific destination.

signalling route-set-test procedure. A procedure, included in the signalling route management, that is used to test the availability of a given signalling route that was previously declared unavailable.

(signalling) traffic flow control. Actions and procedures intended to limit signalling traffic at its source in the case when the signalling network is not capable of transferring all signaling traffic offered by the User Parts because of network failures or overload situations.

signalling traffic management functions. Functions that control and, when required, modify routing information used by the Message routing function and control the transfer of signalling traffic in a manner that avoids irregularities in message flow.

signalling transfer point. A signalling point with the function of transferring signalling messages from one signalling link to another and considered exclusively from the viewpoint of the transfer.

status field. The bits of a link status signal unit that indicate one of the major signalling link states.

subservice field. The level 3 field that contains the network indicator and the message priority.

subsystem number. A number to identify a user of the SCCP, like the ISDN user part.

time-controlled diversion. A procedure, included in the changeback procedure, that minimizes the probability of missequenced messages when a changeback declaration is impossible.

transaction capabilities. Functions that control non-circuit related information transfer between two or more nodes via a signalling network.

transaction capabilities application part (TCAP). The application layer of the Transaction Capabilities protocol.

transaction portion. The portion of the TCAP message that identifies whether the transaction is expected to consist of single or multiple messages and provides a means to associate these messages with a specific transaction and to terminate a transaction.

transceiver. Check-tone transmitter and receiver.

transfer-allowed (procedure). A procedure, included in the signalling route management, that is used to inform a signalling point that a signalling route has become available.

transfer-controlled (procedure), U. S. networks. A procedure, included in the signalling route management, that is used to inform an originating signalling point that a signalling route set is congested and that only traffic with a sufficient priority level should be sent.

transfer-prohibited (procedure). A procedure, included in the signalling route management, that is used to inform a signalling point of the unavailability of a signalling route.

transfer-restricted (procedure). A procedure, included in the signalling route management, that is used to inform a signalling point that a signalling route is not optimal and should be avoided where possible.

transmission buffer. Storage in the signalling link control for signal units not yet transmitted.

transport layer. The layer (Layer 4) that provides end-user to end-user transfer, optimizing the use of resources.

user functions. Functional entities that use the services of the SCCP.

user part. A functional part of the common channel signalling system that transfers signalling messages via the Message Transfer Part. Different types of User Parts exist (e.g., for telephone and data services), each of which is specified to a particular use of the signalling system.

user (of the signalling system). A functional entity, typically a telecommunication service, that uses a signalling network to transfer information.

Chapter T1.110.3

Abbreviations

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Abbreviations

AAL	ATM adaptation layer
ACG	Automatic code gap
ACM	Address complete message
AERM	Alignment error rate monitor
AE	Application Entity
AESA	ATM end system address
AK	Data acknowledgment
ANI	Automatic number identification
ANM	Answer message
AP	Application process
APAB	All-primary/all-backup
APDU	Application protocol data unit
APNB	All-primary/no backup
APSE	All-primary/some backup
ASE	Application service element
ASP	Application service part
ATM	Asynchronous transfer mode
BC	Bearer control
BCC	Bearer connection control
BCD	Binary coded decimal
BCS	Basic combined subset
BCST	Broadcast
BIB	Backward indicator bit
BIBR	Backward indicator bit received
BIBT	Backward indicator bit to be transmitted
BIBX	Backward indicator bit expected
BIC	Bearer identification code
B-ISDN	Broadband integrated services digital network
B-ISDN-UP, B-ISUP	Broadband integrated services digital network user part
BLA	Blocking-acknowledgment message
BLO	Blocking message
BLR	Blocking/unblocking signal reception
BLS	Blocking/unblocking signal sending
BSM	Backward set-up message
BSN	Backward sequence number

BSNR	Backward sequence number received
BSNT	Backward sequence number of next SU to be transmitted
CBA	Changeback acknowledgment signal
CBD	Changeback declaration signal
CC	Connection confirm
CCH	Continuity check indicator
CCI	Continuity check incoming
CCITT	International Telegraph and Telephone Consultative Committee
CCO	Continuity-check outgoing
CCR	Continuity-check-request message
CCS	Common channel signalling
CEI	Connection element identifier
CF	Call Forwarding
CFL	Call-failure
CFN	Confusion message
CGB	Circuit group blocking message
CGBA	Circuit group blocking acknowledgment message
CGC	Congestion control
CGRR	Circuit group reset reception
CGRS	Circuit group reset sending
CGU	Circuit group unblocking message
CGUA	Circuit group unblocking acknowledgment message
CHM	Changeover and changeback messages
CIC	Circuit identification code
CIC	Circuit identification code
CK	Check bits
CL	Connectionless
CMC	Call modification completed message (Not applicable for U.S. networks)
CMP	Component portion
CMR	Call modification request message
CNP	Connection-not-possible signal
CNS	Connection-not-successful signal
CO	Connection-oriented
COA	Changeover acknowledgment signal
CON	Conversation
COO	Changeover-order signal
COT	Continuity message
CP	(AAL) common part
CPC	Call processing control

CPG	Call progress message
CR	Connection request
CREF	Connection refused
CRG	Charging (Note)
CRI	Continuity recheck incoming
CRO	Continuity recheck outgoing
CRR	Circuit reset reception
CRS	Circuit reset sending
CS 1	Capability set 1
CS 2.1	Capability set 2, step 1
CSCC	Coordinated state change control
CSS	Connection-successful signal
CSVR	Closed user group selection and validation request message
CSVS	Closed user group selection and validation response message
CUG	Closed user groups
CVT	Circuit validation test
DAEDR	Delimitation, alignment, error detection (receiving)
DAEDT	Delimitation, alignment, error detection (transmitting)
DCE	Data circuit terminating equipment
DCO	Demand continuity outgoing
DLC	Signalling-data-link-connection-order signal
DLM	Signalling-data-link-connection-order message
DPC	Destination point code
DRS	Delayed release signal
DT1	Dataform 1
DT2	Data form 2
DUP	Data user part
EA	Expedited data acknowledgment message
ECA	Emergency changeover acknowledgment signal
ECM	Emergency changeover message
ECO	Emergency changeover order signal
ED	Expedited data
ERR	Protocol data unit error
EXM	Exit message
FAA	Facility accepted message
FAR	Facility request message
FCM	Signalling traffic flow control messages
FIB	Forward indicator bit
FIBR	Forward indicator bit received
FIBT	Forward indicator bit transmitted

FIBX	Forward indicator bit expected
FISU	Fill-in signal unit
FOT	Forward-transfer message
FRJ	Facility reject message
FSN	Forward sequence number
FSNC	Forward sequence number of the last signal unit accepted by remote level 2
FSNS	Forward sequence number of the oldest message signal unit in the retransmission buffer
FSNL	Forward sequence number of the last message signal unit entered into the retransmission buffer
FSNL	Forward sequence number received
FSNT	Forward sequence number of the last message signal unit transmitted
FSNX	Forward sequence number expected
FU	Functional units
GRA	Reset circuit group acknowledgment message
GRS	Reset circuit group message
GT	Global title
GTAI	Global title address information
H0	Heading code
H1	Heading code
HGA	Hardware carrier group alarm
HMCG	Signalling link congestion
HMDC	Message discrimination
HMDT	Message distribution
HMRT	Message routing
HUA	Hardware group unblocking acknowledgment signal
IAC	Initial alignment control
IAM	Initial address message
ID	Identifier
INF	Information message
INR	Information request message
ISDN	Integrated services digital network
ISDN-UP, ISUP	Integrated services digital network user part
ISP	International signalling point
IT	Inactivity test
ICC	Incoming trunk circuit
L1	Level 1 (physical/electrical interface)
L2	Level 2 (signalling link functions)
L3	Level 3 (signalling network functions)
L4	Level 4 (e.g., ISDN user part)
LATA	Local access and transport area

LBCS	Local broadcast
LFU	Link forced uninhibit message
LI	Length indicator
LIA	Link inhibit acknowledgment message
LID	Link inhibit denied message
LIN	Link inhibit message
LLI	Link local inhibit signal
LLSC	Link set control
LPA	Loop-back acknowledgment message
LRI	Link remote inhibit test signal
LSAC	Signalling link activity control
LSB	Least significant bit
LSC	Link state control
LSDA	Signalling data link allocation
LSLA	Signalling link activation
LSLD	Signalling link deactivation
LSLR	Signalling link restoration
LSSU	Link status signal units
LSTA	Signalling terminal allocation
LUA	Link uninhibit acknowledgment
LUN	Link uninhibit message
MAP	Mobile Application Part
MBA	Maintenance group blocking acknowledgment signal message
MGB	Maintenance group blocking signal
MGMT	Management system
MGU	Maintenance group unblocking signal
MIM	Management inhibiting messages
MMI	Human machine interface
MPC	Maintenance process control
MRVT	MTP routing verification test
MSB	Most significant bit
MSU	Message signal unit
MTP	Message transfer part
NACK	Negative acknowledgment
NASP	Network application service part
NI	Network Indicator
NNI	Network node interface
NP	Network pause
NPCI	Network protocol control information
NPNB	No-primary/no-backup

NR	Network resume
NSAP	Network Service Access Point
NSDU	Network service data unit
NSP	National signalling point or Network service part
OA&M	Operation, administration and maintenance
OGC	Outgoing trunk circuit
OMAP	Operations, Maintenance and Administration Part
OPC	Originating point code
OPDU	Operation protocol data unit
OPT	Optional
OSI	Open systems interconnection
OSS	Operation support system
P _e	Emergency proving period
P _n	Normal proving period
PAM	Pass along message
PDU	Protocol data unit
PER	Permission
PC	Point code
PCI	Protocol control information
PCM	Pulse-code modulation
PCR	Preventive cyclic retransmission
PDU	Protocol data units
PIN	Personal identification number
POC	Processor outage control
PPDU	Presentation protocol data unit
QRY	Query
RC	Reception control
RCAT	Signalling-route-set-congestion-test control
RCM	Reject connect modify message
RCP	Signalling-route-set-test cluster-prohibited signal
RCR	Signalling-route-set-test cluster-restricted signal
RCT	Signalling-route-set-congestion-test signal
RE	Return error
REL	Release message
RES	Resume message
RID	Response ID
RLC	Release complete message
RLSD	Released message
RR	Return result
RSC	Reset-circuit message

RSCM	Reset confirmation message
RSM	Signalling-route-set-test message
RSP	Signalling-route-set-test prohibited signal
RSR	Signalling-route-set-test restricted signal
RSRM	Reset request message
RSRT	Signalling route set test control
RST	Reset-circuit
RTAC	Transfer allowed control
RTB	Retransmission buffer
RTC	Restart confirmation
RTCC	Transfer-controlled control
RTPC	Transfer prohibited control
RTRC	Transfer-restricted control
SAAL	Signalling ATM adaptation layer
SACF	Single association control function
SAO	Single association object
SAM	Subsequent-address message
SBR	Subsystem-backup-routing
SBRC	Subsystem backup routing control
SCCP	Signalling connection control part
SCGA	Software carrier group alarm
SCLC	SCCP connectionless control
SCMG	SCCP management
SCOC	SCCP connection oriented control
SCRC	SCCP routing control
SDL	Specification and description language
SDU	Service data unit
SF	Status field
SGB	Software group blocking signal
SGM	Segmentation message
SGU	Software group unblocking signal
SI	Service indicator
SIB	Status indication "B" ("Busy")
SIE	Status indication "emergency alignment"
SIF	Signal information field
SIN	Status indication "normal alignment"
SIO	Service information octet
SIOA	Status indication "out of alignment"
SIOS	Status indication "out of service"
SIPO	Status indication "processor outage"

SLC	Signalling link code
SLM	Signalling link management
SLS	Signalling link selection code
SLTA	Signalling link test message acknowledgment
SLTC	Signalling link test control
SLTM	Signalling link test message
SMAE	Systems management application entity
SMAP	Systems management application process
SMH	Signalling message handling
SMI	Subsystem multiplicity indicator
SNR	Subsystem-normal-routing message
SNRC	Subsystem normal routing control
SOG	Subsystem-out-of-service-grant message
SOR	Subsystem-out-of-service-request message
SP	Signalling point
SPAC	Signalling point allowed control
SPC	Signalling point code
SPDU	Session protocol data unit
SPNB	Some-primary/no-backup
SPPC	Signalling point prohibited control
SPRC	Signalling process control
SPSB	Some-primary/some-backup
SRM	Signalling route management
SRT	Subsystem-routing status-test message
SRTC	Subsystem routing status test control
SRVT	SCCP routing verification test
SS7	Signalling system no. 7
SSA	Subsystem-allowed message
SSAC	Subsystem allowed control
SSCF	Service specific coordination function
SSCOP	Service specific connection oriented protocol
SSD	Second start dial
SSF	Sub-service field
SSN	Subsystem number
SSP	Subsystem-prohibited message
SSPC	Subsystem prohibited control
SST	Subsystem-status-test message
SSTC	Subsystem status test control
ST	End-of-pulsing signal
STDs	State transition diagrams

STM	Signalling traffic management
STP	Signalling transfer point
SU	Signal unit
SUA	Software group unblocking acknowledgment signal
SUERM	Signal unit error rate monitor
SUS	Suspend message
TB	Transmission buffer
TC	Transaction capabilities
TCA	Transfer-cluster-allowed signal
TCAP	Transaction capabilities application part
TCBC	Changeback control
TCOC	Changeover control
TCP	Transfer-cluster-prohibited signal
TCR	Transfer-cluster-restricted signal
TCRC	Controlled rerouting control
TPA	Transfer-allowed signal
TFC	Transfer-controlled signal
TFM	Transfer-prohibited, transfer-restricted and transfer-allowed messages
TFMI	Traffic mix information
TFP	Transfer-prohibited signal
TFR	Transfer-restricted signal
TFRC	Forced rerouting control
TID	Transaction ID
TLAC	Link availability control
TMN	Telecommunication Management Network
TP	Test pattern
TPCPI	Transaction portion component portion interface
TRA	Traffic restart allowed
TRCC	Signalling route congestion control
TRD	Timed release disconnect
TRP	Transaction portion
TRW	Traffic restart waiting
TSFC	Signalling traffic flow control
TSRC	Signalling routing control
TUP	Telephone user part
TXC	Transmission control
UBA	Unblocking-acknowledgment message
UBL	Unblocking message
UI	Unrecognized information
URM	Unsuccessful-backward-set-up-information message

UDT	Unitdata message
UDTS	Unitdata service message
UIS	User-in-service
UNB	Counter of unreasonable BSN
UNF	Counter of unreasonable FSN
UNI	Unidirectional
UOG	User-out-of-service-grant
UOR	User-out-of-service-request
UOS	User-out-of-service
UP	User part
USR	User-to-user information message (for further study)
VC	Virtual channel
VCC	Virtual channel connection
VCI	Virtual channel identifier
VPC	Virtual path connection
VPCI	Virtual path connection identifier
VPA	Voice path assurance
XUDT	Extended Unit Data Transfer

Chapter T1.110.4

Annotation and Format Rules

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Annotation and Format Rules

1. Text Changes

Changes are indicated by the appropriate annotation in the right margin.

2. Spelling

The document uses ITU-T spelling (e.g., signalling).

3. Non-ITU-T Features

Each Signalling System No. 7 Protocol indicates its major differences relative to the corresponding ITU-T Recommendations.

4. Figures and Tables

All tables and figures are formatted according to the ANSI style and numbered consecutively. Tables and figures are listed in the Table of Contents.

The figure/table captions have the form "Figure 1/T1.110.1 (Sheet X of X) - Title" or "Table 1/T1.110.1 - Title." Figures referenced in other volumes and chapters, use the notation "Figure 1/T1.110.1." Figure captions appear below figures and table captions appear before tables.

Example:

Figure 1/T1.110.1 - Examples of Signalling Modes

Figures and tables in appendixes are listed with alphabetic notation of the appendix followed by the figure number.

Example:

Figure A1/T1.110.1

Figures and tables in annexes are listed with alphabetic notation of the annex followed by a dash and then the figure number.

Example:

Figure A-1/T1.110.1

5. New Section Numbers

Sections were added in the most appropriate positions. The section number of a new section consists of the previous section number (of the same level in the structure) suffixed with a capital letter, starting with "A".

Example:

"Section 5.3

Section 5.3.1

Section 5.3A (new)

Section 5.3A.1 (new)

Section 6"

6. Future Editions

Any future editions will have the changes from the last previous edition indicated by bars, "I" in the right margin.

Example:

"The signalling route set congestion status is the minimum of the signalling route congestion status of the routes making up the route set." |

7. Clarification Text

Any text that has been added to clarify a description has been indented from both margins and the phrase "(clarification)" added at the beginning.

Example:

"(Clarification) The Circuit Identification Code (CIC) is a binary representation of the number of the trunk to which the message relates. The four last significant bits of the circuit identification code form the Signalling Link Selection (SLS) field that is used for load sharing to ensure that messages related to a particular call are always routed on the same signalling link." |

8. SDL Diagram Symbols

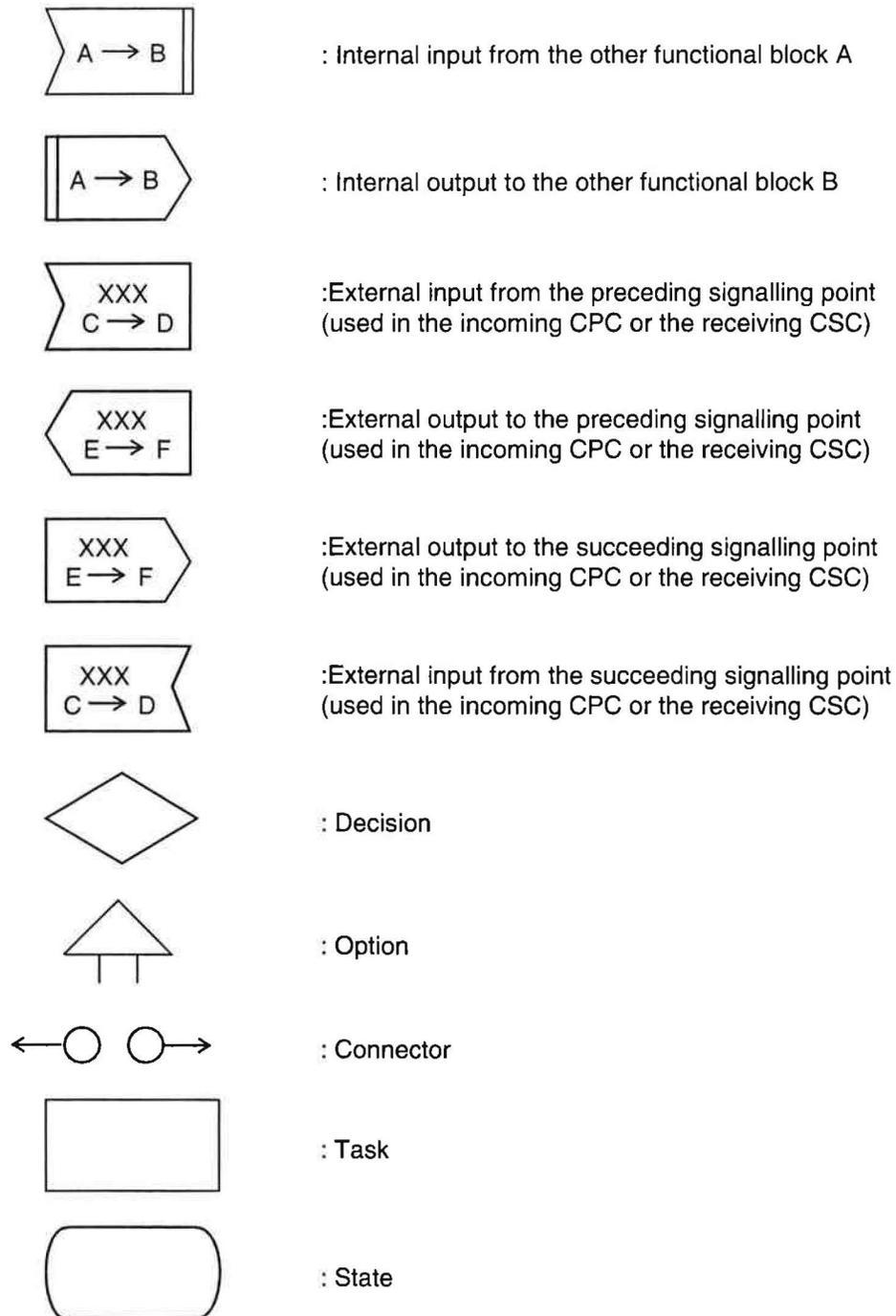
Figure 1/T1.110.4 explains the symbols most commonly used in the SDL diagrams in the ANSI SS7 Specifications.

9. Text Change Legend

The following legend has been put on at least the first page of each chapter to explain the annotation practices used in the right margin to indicate text changes in this issue.

Legend:

A "I" indicates a change from the previous issue.



Note - Input which is not shown in SDL diagrams should be discarded.

Figure 1/T1.110.4 - Symbols used in SDL diagrams

